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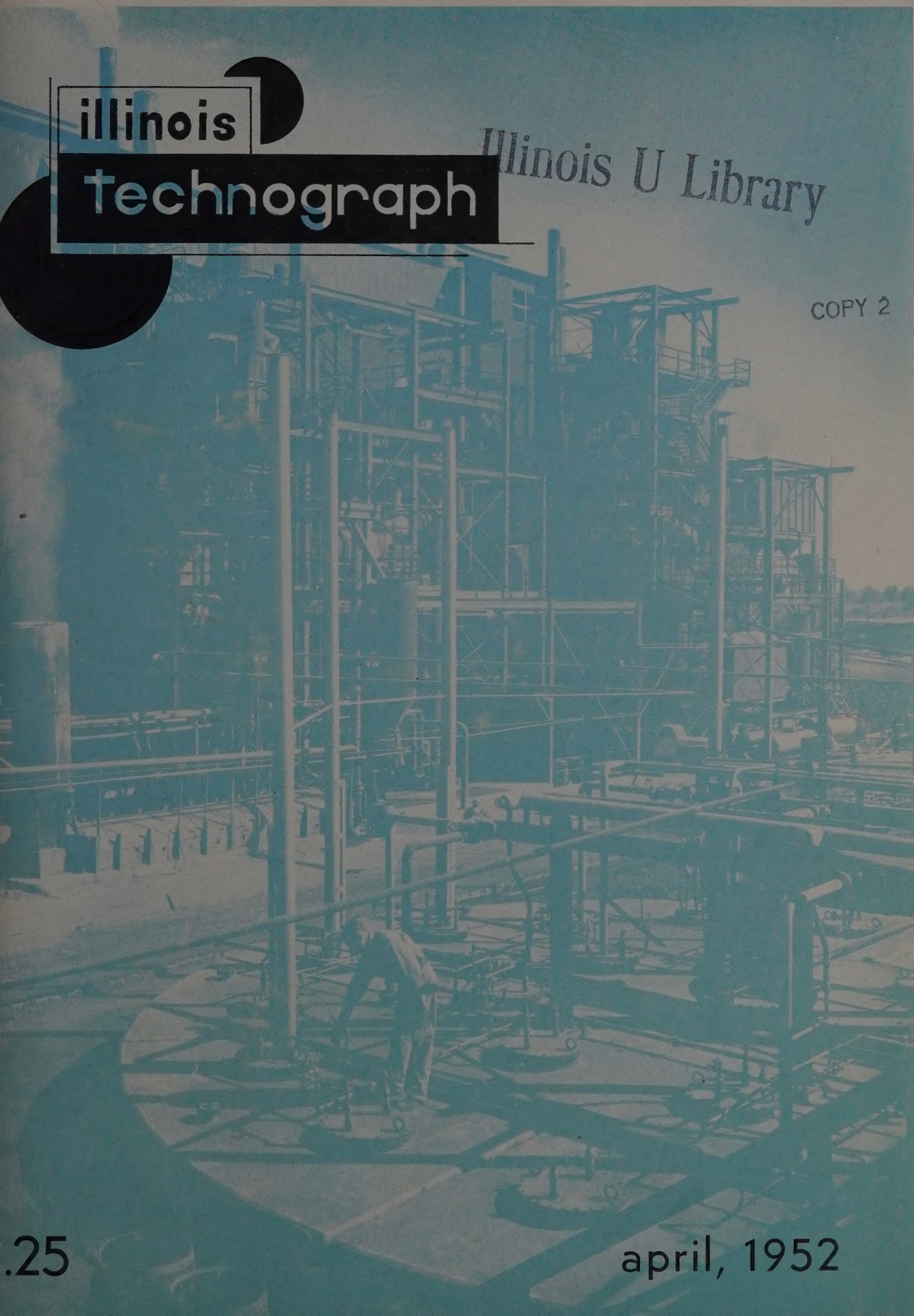

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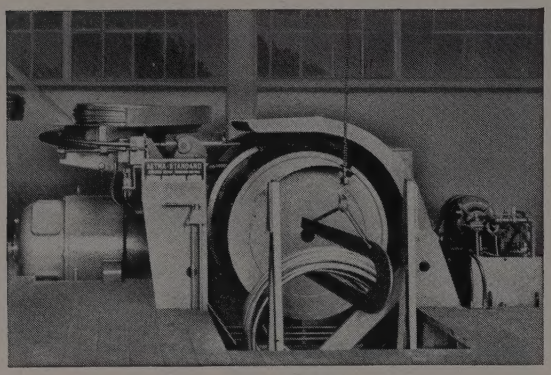
april, 1952

Another page for **YOUR BEARING NOTEBOOK**



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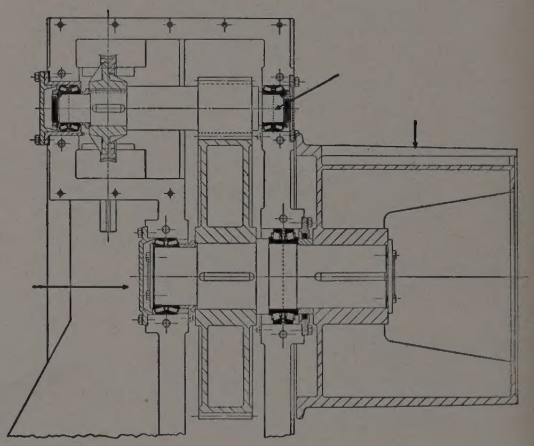

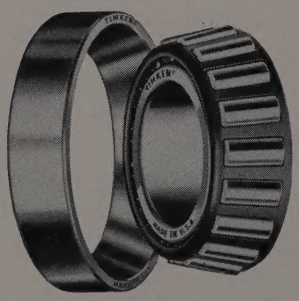

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It's Up to You . . .

The recent disclosures of diminishing reliance on moral principles on the campus, in government and in certain industries prompts a re-examination of the character of professional ethics as related to the engineer.

A recitation of the recapitulation of the Code of Ethics as prescribed by the Western Society of Engineers seems in order, it follows: "The ethical standards of the engineering profession should be those of a fraternity. The engineer should recognize that he is endowed by the profession and the state with specialized knowledge for peculiar judicial and responsible public service involving the life, safety, comfort and convenience of his own and coming generations, and that in response to these he should so conduct himself as to be appreciative of his indebtedness to his profession for his opportunity and make return by every effort, by a life of special usefulness devoid of unseemly greed, and filled, if possible, with a multitude of those small courtesies, the practice of which encourages the spirit of forbearance and is helpfully conducive to the fine art of living well together."

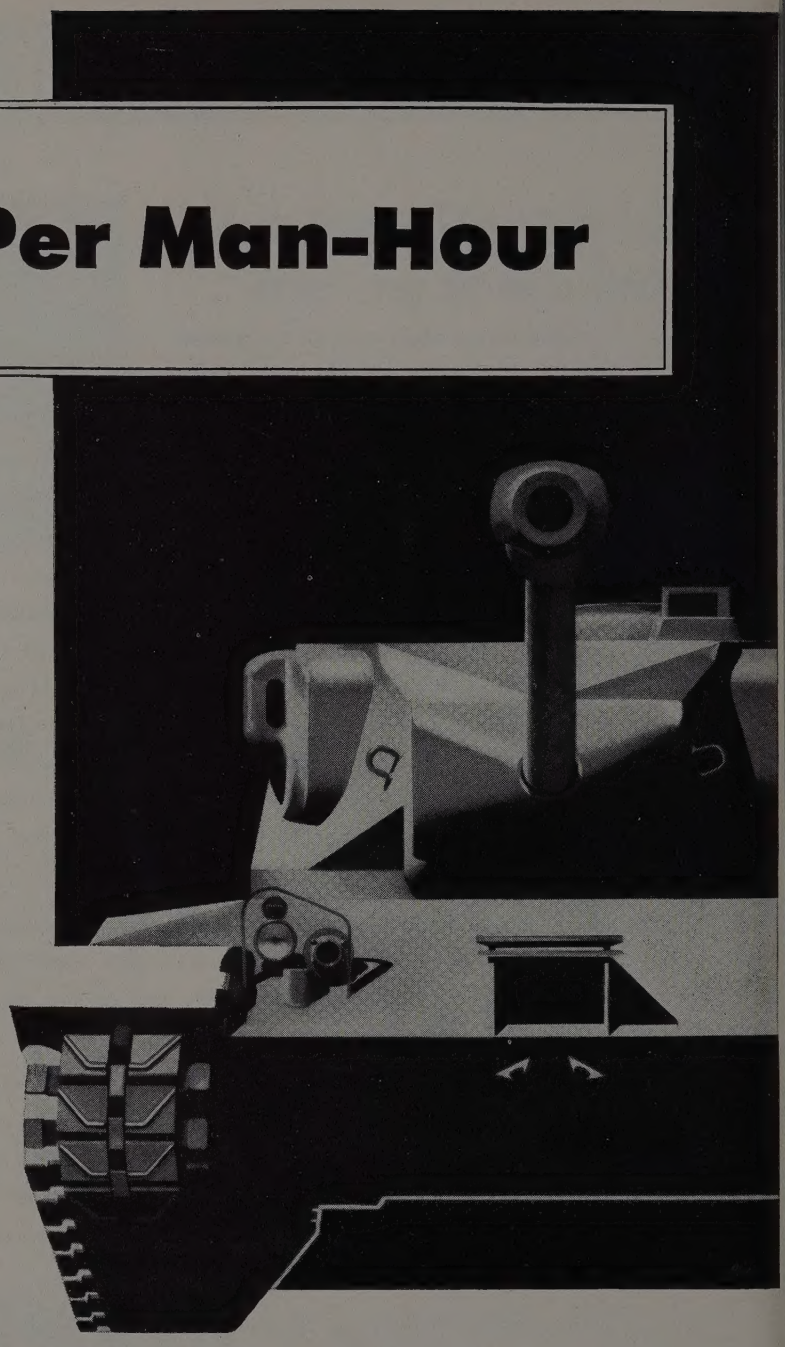
It is significant, I believe, that by and large, professional engineers have not been involved in scandals associated with public morals. The engineer has been tutored well in the classroom, and on the job, along the paths of fair dealing, trustworthiness and honesty.

The heritage of the engineer is one of devotion to duty, perserverance and unimpeachable conduct. One who might be inclined toward devious practices might well examine the life histories of those engineers who made this country great. The engineer in social, professional or political life has consistently conformed to his code and the public has rewarded him for it.

But let's not think the battle is over. Each one of us, every day, is faced with alternate solutions of an ethical situation which must be met. The way we handle them while we are in the classroom will be a guide to the methods of attack to be employed in later life.

The standards have been set down, the rest is up to you.—W.H.B.

More Per Man-Hour



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volume 67 number 7

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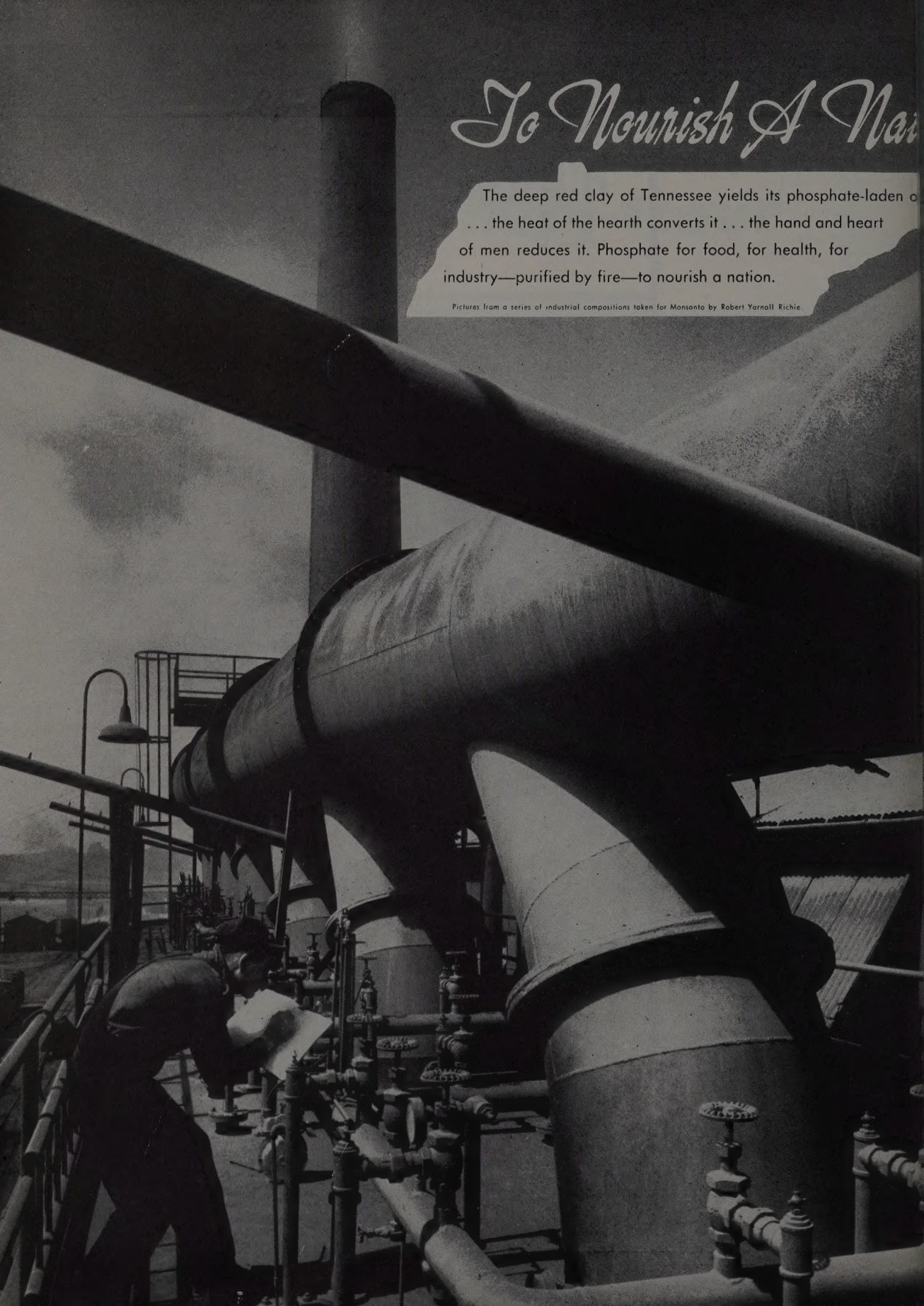
our cover

The chemical industry, so vital to our security, is exemplified in this view of a Tennessee phosphate plant. The chemical engineers we salute in this issue are helping to provide America with the materials she needs for farm, home and industry. Chemistry has taken the processes of nature and applied them to the needs of man. (Cut courtesy Monsanto Chemical Company).

our frontispiece

"To Nourish a Nation," the chemical industry has led in the development of fertilizers, food preservatives and important by-products associated with food processing. The phosphate industry is a leader in providing much needed nutrients in the soils of America's farms. Chemical engineers have developed numerous additives to soils which enable the farm to increase land output. (Cut courtesy Monsanto Chemical Company).



To Nourish A Nat

The deep red clay of Tennessee yields its phosphate-laden o . . . the heat of the hearth converts it . . . the hand and heart of men reduces it. Phosphate for food, for health, for industry—purified by fire—to nourish a nation.

Pictures from a series of industrial compositions taken for Monsanto by Robert Yarnall Richie.

cracking the whip over . . .

THE BIG CATS

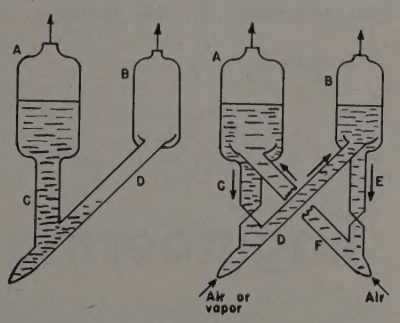
by Daniel Stanfill

The fluid catalytic cracking process emerged from the laboratory during the war years. Today it shows many advantages over other processes used by the industry. Once a unit is running, the heat requirements of the various parts of the unit are balanced by the heat generation of other portions, and little, if any, outside heat is required. Higher yields of the most desirable products are obtained and only a small percentage of these products need further processing. It can successfully crack naptha cuts, kerosene, light or heavy gas oil, and some types of reduced crude oil. It can be operated to produce either aviation gasoline, high grade motor gasoline, or raw materials for the production of chemicals and synthetic rubber. The simplicity of the process eliminates expensive, intricate mechanical equipment. Continuous and very accurate control may be accomplished simply by using valves.

The catalyst cracking process also allows great flexibility of operating conditions. Such things as the catalyst-to-oil ratio and space velocity permit changing the relationship of desirable products over a wide range to meet market demands. Today, the catalytic process has largely replaced other processes and is a basic tool for breaking down long-chain and high-molecular-weight hydrocarbons into molecules that boil within the gasoline temperature range.

The fluid catalytic cracking process employs a finely divided catalyst suspended in gas or vapor, so that it flows through the equipment with flow characteristics resembling those of a liquid. The catalyst is brought into intimate contact with the oil, causing the oil to change its molecular structure.

The success of the process depends upon the fluid principle. As with most engineering designs, the idea is quite ingenious but is relatively simple in theory. In the accompanying diagram (figure 1), it is desired to move the catalyst from vessel A to vessel B. The powdered catalyst (average particle diameter, 0.002″) falls down pipe C, but at the junction of C and D it packs tightly and the flow is stopped. By two simple additions, the catalyst can be made to flow from A to B, and at the same time a complete cycle is set up. These changes are shown in figure 2. By the addition of a valve at the lower end of standpipe C, and the injection of air or vapor at the bottom of D, a carburetor condition is set up which carries the catalyst aloft as a fluid to vessel B. No mechanical force is used; the pressure head maintained in A plus



Figures 1 and 2

the force of the hot partially-packed catalyst in C is sufficient to overcome the opposing forces—the pressure in B, the force of gravity, and friction loss during the movement through D. A similar set of return pipes, E and F, are attached to vessel B and the cycle is complete.

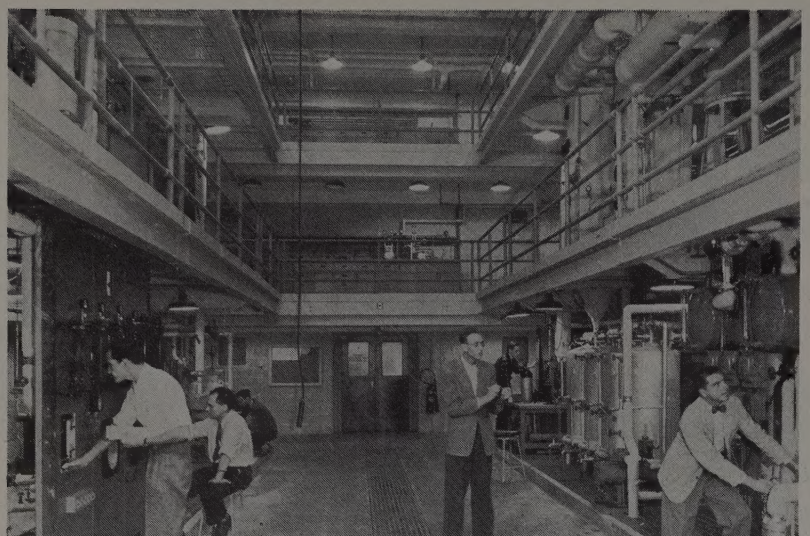
In actual operation, vessel A is the regenerator for spent catalyst, and vessel B is the reactor for the fresh catalyst and oil vapor charge. Some of the numerous advantages of this fluid principle are as follows: A highly turbulent bed in the reactor (vessel B) provides intimate contact between catalyst and vapor. The ability to closely control reaction conditions over a wide range produces optimum yields with uniform quality of products. Continuous uniform regeneration (in pipe F and vessel A) is obtained with a minimum degradation of catalyst activity. The fluid catalyst may be circulated freely without regard to limitations of mechanical transfer equipment. Flows are maintained by self-perpetuating hydrostatic heads (at the bottom of pipes D and F.)

The principle disadvantage of the catalyst cracking process is the eroding or "sandblasting" effect that the moving catalyst particles have on the equipment. A wide variety of catalysts are used. For example, a synthetically produced silica-alumina catalyst yields the highest octane number and a lesser amount of gasoline, while more gasoline with a lower octane number is produced by using a natural silica-alumnia catalyst. Yet the only difference between these two silica-alumina catalysts is in their physical form; the synthetic is smooth and has less exposed surface per unit of mass than the natural rough-ground catalyst.

Figure 3 shows a simplified diagram for a typical M. W. Kellogg Fluid Catalytic Cracking Unit. Hot catalyst at a temperature of approximately 1100°F passes from the regenerator into the regenerator standpipe and flows down to the oil injection point where it flash-vaporizes the fresh-oil charge which has been preheated to balance the total heat requirements of the reaction. The mixture of oil vapors and catalyst is forced up the reactor feed line by the pressure head maintained in the regenerator plus the force of gravity exerted on the dense catalyst in the catalyst standpipe, the pump serving merely to bring the oil to the oil injection point. The hot mixture then enters the reactor where the catalyst settles to a well-defined level and forms a bed, the depth of which regulates the time of reaction. The bed is maintained in a fluid turbulent condition by the entering feed vapors. Continually passing upwards, these oil vapors effect intimate contact with the catalyst and produce a uniform temperature (900-950°) throughout the bed. As cracking progresses, coke is formed on the catalyst.

The spent catalyst, laden with coke, is continually and automatically withdrawn through a slide valve to the spent-catalyst stripper, where the adsorbed and entrained vapors are dissociated from the catalyst and carried by a counter stripping medium back into the top of the reactor vapor space. Spent catalyst in the stripper separates

(continued on page 26)



The Unit Operations Laboratory, largest laboratory in the building, extends through three stories.

the Technograph features the . . .

Chemical Engineering Division

by Tom Tucker, ch.e. '53

In this day, it is news when an engineer has time for athletics, but in 1868, one year after the University was chartered, every chemistry student at Illinois could be found on the baseball diamond. However, it was not as easy a life as it appears to have been—the department of chemistry was located in a building on the playing field. Setting a precedent which is still being followed, the department grew until a new building was constructed for it. That building is still standing. It is so small that most students can not see why it was ever built. The building is Harker Hall.

In 1891, a young man named Samuel Wilson Parr came to the University as a professor of applied chemistry. Ten years later, he initiated the curriculum of chemical engineering at Illinois, one of the first five in the country.

At the beginning of this century, there were no chemical engineers as we know them today. The industrial chemist found the best method for production on a commercial basis by trial and error. He paid little, if any, attention to the mechanical end of production, leaving this entirely in the hands of the mechanical engineer. The mechanical engineer did his job on a cut-and-try basis. Neither the chemist nor the engineer made any effort to see the other's problems. This was the situation when the chemical engineer entered.

At the dedication of the East Chemistry building in March, 1951, Doctor Donald B. Keyes, formerly of the University faculty and now with the Heyden Chemical corporation, made the following statement on the nature of chemical engineering: "Chemical engineering is the art of translating test tube results from the chemical laboratory into full-scale commercial production. If success is obtained, the business prospers and the public is benefited both from the standpoint of health and happiness."

Chemical engineering requires an extensive background of chemistry. For a bachelor's degree, the Illinois chemist takes only 18 more hours in chemistry than does the engineer. Of these 18 hours, 12 are electives which the engineer often takes.

The second requirement for a chemical engineer is a thorough knowledge of the unit operations: fluid flow, heat transfer, distillation, evaporation, and filtration. It is the policy of the curriculum, according to Doctor H. F. Johnstone, head of the division, to provide the fundamentals, at both the undergraduate and graduate levels, in such a way that the chemical engineer from Illinois can work in any chemical industry. The student is taught analytical thinking and interpretation of data as well as the basic subject matter. He is trained in such a way that he can do many of the jobs of the electrical or mechanical engineer.

That the division has lived up to its aims in the past is evident from the success and reputation of its graduates. Among the best known are Professor E. R. Gilliland, '30, head of chemical engineering at M.I.T.; Professor E. W. Comings, '30, head of chemical and metallurgical engineering at Purdue; Frank Smith, '30, manager and director of research of Pan American Petroleum Company; Dotor D. M. Wroughton, '30, head of the Atomic Energy Division of the Westinghouse Company; Doctor R. L. Pigford, '42, University of Delaware; Doctor W. L. Faith, Ph.D. '32, Corn Products Refining Company; Doctor N. W. Krase, '18, of the Du Pont Corporation; S. D. Kirkpatrick, '16, McGraw Hill. Book Company; and many other Illini chemical engineers.

Further evidence of the quality of the work of the division is found in the number of prize-winners in the student contests sponsored by the American Institute of Chemical Engineers. In 17 years of competition, the University has won five first prizes and six other prizes, a record which surpasses that of any school in the country. The University of Illinois also ranks first in the number of undergraduate students who go on to take advanced degrees in chemical engineering. Doctor Johnstone and his staff encourage their students to take graduate work at some other school in

rder to broaden their training and get different viewpoint.

Still another first belongs to chemical ngineering, Illinois style. The first aboratory to study high pressure reacon in any university in the country as established here in 1926.

Since the curriculum was started in 901, about 1300 students have received he degree of Bachelor of Science in hemical engineering. The largest numer of graduating seniors was 88 in 946. At present, there are 155 undergraduate chemical engineering students nd 33 graduate students on the campus. Other undergraduate students are enolled at Chicago Undergraduate Division at the Navy Pier.

There are two optional curricula in hemical engineering, one requiring four ears of study and the other five years. The four-year curriculum is for the high chool graduates who have had good raining in high school chemistry, physics, mathematics, and German or rench. In this curriculum, there are number of special courses which are ffered only to chemists and chemical ngineers. These courses have accelerated schedules which are made possible y the excellence of the high school raining. For students who can not get he training necessary for the four-year urriculum, the five-year course has een established. This is essentially the ame as the shorter course with the difference in the number of hours of elementary chemistry, mathematics, and anguage. There are also more electives in the five-year curriculum, so that more liberal arts and economics courses may be taken. Students who are particularly interested in sales and administration in the chemical and oil industries often take the longer curriculum.

With the value of audio-visual education in mind, a fully equipped projection booth was placed in the main lecture room.

The division of chemical engineering also offers an optional curriculum in bioengineering for students who are interested in the fields of industrial fermentation, antibiotics, pharmeceuticals, and the like. Graduates of this option receive the same degree in chemical engineering as those in the regular curriculum. Illinois was among the first to offer training in this field. In charge of bioengineering is Doctor R. K. Finn. Doctor Finn came to Illinois three years ago from the University of Minnesota.

It was mentioned earlier that the chemistry laboratory was formerly located in Harker Hall. In 1901, the department moved into a new and larger laboratory which is now the west half of Noyes laboratory. The east portion of that building was added in 1916. Then the Chemistry Annex was built in 1932. Still there was not enough room for "the strongest department of chemistry in the country," as it is referred to by Doctor James B. Conant, president of Harvard University. In 1947, construction was started on the new East Chemistry building for the chemical engineering and biochemistry divisions of the department. This $3,400,000 building was opened to classes in February, 1950.

The facilities of the new building are unsurpassed by any college laboratory in the country. Of the seven floor levels in the building, two are devoted to ventilation and maintenance.

The main laboratories in the new building are the unit process laboratory, the high pressure laboratory, the unit operations laboratory, and the process development laboratory. The high pressure laboratory, located on the ground floor, is capable of working up to 100,000*psi*. It is the only one of the four laboratories which does not occupy more than one floor level.

The process development laboratory, or pilot plant, runs through the third and fourth floors. There are two steel-grill mezzanines above the lower floor level at 9 and 16 feet. These mezzanines provide three working levels to enable the operation of tall equipment in the laboratory. It is in laboratories such as

(continued on page 28)

The main lounge of the East Chemistry building features the latest developments in modern design and comfort.

engineers strut their stuff at the . . .

1952 Engineering Open House

by John Schultz, cer.e. '52

St. Patrick made his initial appearance on campus this year inconspicuously and ahead of schedule. He arrived on the night of March 12, two days before he was expected, in a green sawed-off rocket ship which landed on the lawn of the Electrical Engineering Building in the dead of night. Though nobody saw him land, the evidence of his presence was unmistakable. The rocket ship had been spotted hurling toward the area from outer space several days before by celestial observers, but the time of his arrival could not be determined. On the morning of Thursday, March 13, however, a group of engineers returning home after burning the all-night study oil spotted the contraption, which upon investigation proved to be that of the patron saint himself.

It was later discovered that the purpose of St. Pat's unexpected early arrival was to discover the whereabouts of the Blarney Stone, missing since two years ago.

But when no word was heard from him, it was feared that he also had become lost, strayed, or kidnaped. However, he returned in time to start off the festivities on Friday, emerging ragged and worn from a Green Street sewer. By that time a large crowd of spectators had assembled on the engineers' domain, awaiting the arrival of the man without whom Open House activities could not start. St. Patrick announced that his search for the Blarney Stone had been futile, although he had unrelentlessly traced down the rumor that the Stone was in the possession of some unscrupulous Ag students.

St. Pat then got aboard his waiting green convertible and toured the campus, followed by the parade of floats. Leading the parade was a huge green snake, carried by members of Sigma Phi Delta, engineering social fraternity.

The parade consisted of floats designed by various engineering societies and fraternities. Among the more eye-filling floats was one built by members of the American Foundryman Society carrying the slogan "We Make Models." Riding the float was a model, the like of which is seldom seen even in the most modern foundry.

The aeronautical engineers' float also brought forth whistles and wolf-calls. Entitled "Venus or Bust," it had both.

The trophy for the best float was given to the boys of the American Society of Mechanical Engineers.

After the passing of the parade, the crowd rapidly dispersed to view the multitude of displays in the buildings surrounding the Boneyard. The first stop on the program was Talbot Laboratory. The show-stopper here was an impressive demonstration of the breaking of a large concrete cylinder by the 3,000,000 *lb.* hydraulic testing machine. The cylinder was shattered like a match-stick by the steel muscles of this Samsonian machine.

Other exhibits demonstrated by the department of theoretical and applied mechanics included the testing of structural joints on a 200,000 *lb.* repeated load machine, determination of engineering properties of soils, different mechanical vibration systems, and special equipment and specimens of plastics and laminations.

From Talbot Lab, the arrows led to the Foundry where castings were made of different metals; to Aeronautical Laboratory B, where airplane engines and models were on display; to the Mechanical Engineering Laboratory, where power units and other equipment were demonstrated; thence to the Transportation building. The general engineering drawing department, harbored in the Transportation building, won the trophy for the best exhibit. The displays included 19 patent drawings which have changed civilization, drafting equipment; 50 different types of slide rules; and aircraft drawing and lofting. The use of the airbrush was demonstrated, as were methods of reproducing engineering drawings, and the use of black light in teaching descriptive geometry. Souvenirs were given to the visitors.

The Mining Laboratory offered demonstrations of mining apparatus and displays. The Metallurgy Lab housed demonstrations of metal crying out loud, heat treatment of metals, and microscopic examination of metals. Movies also were shown.

The wind tunnel was in operatio in Aeronautical Lab A.

One of the popular exhibits in th Ceramics building was the making o souvenir porcelain enameled "dog-tags, on which visitors were invited to writ their names. Green-glazed clay sham rocks also were given away as souvenir while the supply lasted. Among the ex hibitions given by the ceramics boy were: jiggering, throwing, and slip cast ing of pottery; brick making; and smelt ing of enamels. Microscopy and pyrom etry equipment were displayed, as wel as many types of ceramic wares.

The mechanical engineers exhibite methods of tool designing, welding, hea treating, and machining; internal com bustion engines; thermodynamic studies and fuels and lubricants.

A lecture demonstration of variou physical phenomena was given in th Physics Laboratory; and displays o light and sound were offered. The phys icists also conducted a tour of the Beta tron building.

Civil engineers and sanitary engineer exhibited and explained all phases o their fields in Civil Engineering Hall Two popular movies were shown.

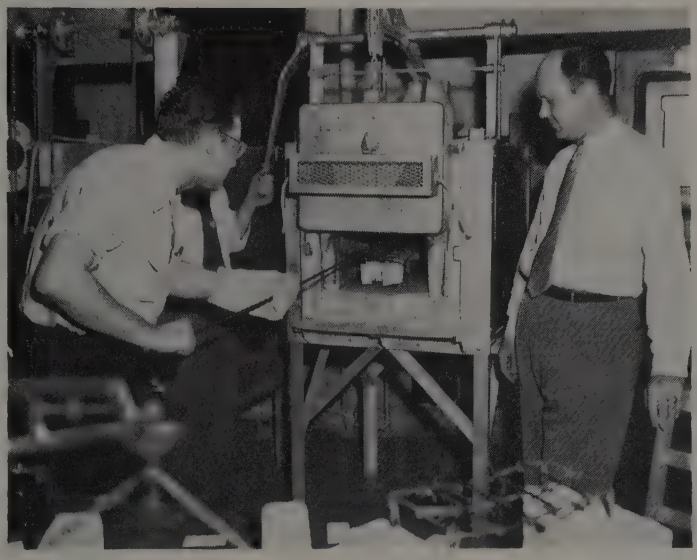
The final stop on the engineerin campus was the Electrical Engineerin building, where power, communications electronics, and illumination were wel represented.

The new Chem Engineering build ing also was on the Open House list The six fundamental operations o chemical processes were demonstrate in the unit operations lab. These are distillation, extraction, filtration, hea transfer, absorption, and evaporation Free hydrogen hydroxide cocktails wer featured. St. Pat's weekend had a dou ble meaning for the Chem E's, for th AIChE held its regional convention her at that time.

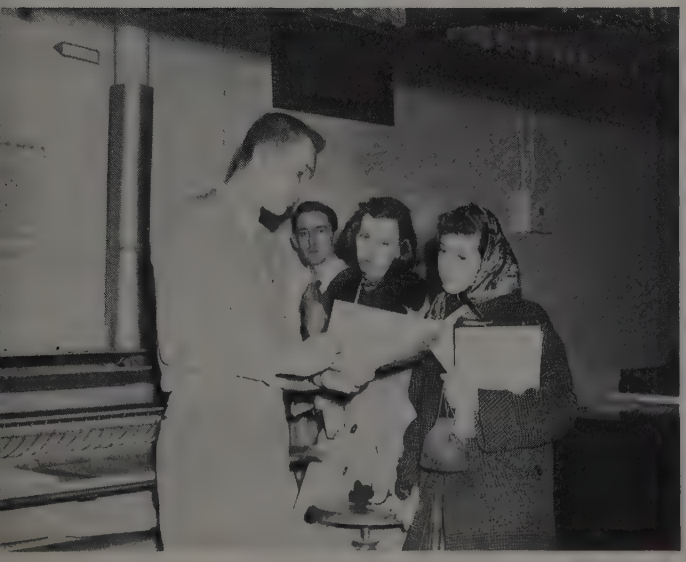
Free bus service was given to th Chemical Engineering building, and t the Ag Engineering building, Armor Abbott Power Plant, Betatron build ing, and the Railway Exhibit.

The Open House was closed at 6:0 p.m. Saturday to allow the all-but exhausted engineers to spruce up fo St. Pat's Ball, a fitting climax to busy weekend.

Above: T.A.M. department tests strength of concrete cylinders. Right: Kiln baking process used for ceramics. Below: Weaker sex admires prize-winning G.E.D. display.



Above: AFS float passes in review during Open House Parade. Below: After effects of strength testing in Talbot Lab.



introducing . . .

by Oliver Smith, m.e. '54, Duane Loofbourrow, gen.e. '53 and Tom Madden, m.e. '54

ROBERT K. FINN

Students at the University of Illinois found that in the fall semester of 1949 a new course had entered the time table. Entitled "bio-engineering," this course was found in the chemical engineering division and was instructed by Robert K. Finn, assistant professor of chemical engineering. Only the beginning of a large undertaking by the professor, this course was the pioneer for a new curriculum in bio-engineering.

Professor Finn, who instituted the new option at Illinois, was born in Waukesha, Wisconsin, and received his elementary and high school education there. Upon graduation from high school he went on to Cornell University where he obtained his bachelors degree in chemistry and chemical engineering. Being interested in biochemistry,

ROBERT K. FINN

Finn then obtained his masters degree doing much work in bacteriology.

During the war years and immediately preceding the war he was employed by Merck and Company in Rahway, New Jersey. Much of his time there was spent in the development of the wonder drug, penicillin.

In 1946, Robert Finn began work at the University of Minnesota for his Ph.D. in chemical engineering. Having received his degree he came to teach at the University of Illinois in the fall of 1949. His major assignment was the establishment of the course in bio-engineering.

Because of his intense interest in biochemistry Dr. Finn has little time for hobbies. He does, however, maintain physical agility by playing tennis in the summer and handball in the winter. At present he is attempting to develop improved respiratory methods for microorganisms in fermentation.

Dr. Finn and his wife made a 1,000 *mi.* bicycle tour of some of the European countries last summer. On a suggestion, they hitch-hiked through Britain and then purchased bicycles to complete the tour. Their back-road excursions led them through Holland, Germany, Austria, Switzerland, and some of the other well-known European nations. Thoroughly enjoying themselves, the Finns found Europe both hospitable and beautiful, even in this day of international friction.

Although he is kept busy as the adviser of the U. of I. Student Branch of the American Institute of Chemical Engineers, Finn still finds time to devote to other organizations. Currently he is a member of the American Chemical Society, the Society of American Bacteriologists, and the honorary fraternities Phi Lambda Epsilon and Sigma Xi. Being the adviser of the Student Branch he is also, of course, a member of the AIChE.

■

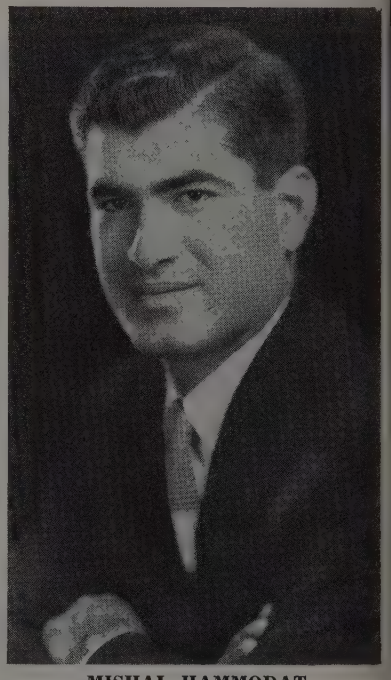
MISHAL HAMMODAT

Mishal Hammodat, vice president of the Engineering Council, is gaining experience in diplomatic "bridge" building through his activities on the Council this semester. "The Bridge" that Mishal is interested in is not the kind civil engineers usually think about, however. It's the name of the house for University of Illinois engineering students to be sponsored next fall by the Council's international student activities committee, of which Mishal is chairman. Half the residents of the house will be American students and the other half will be foreign students. Their common purpose will be to bridge the gap between the engineering students of the world.

Mishal was born in Mosul, Iraq, and graduated from the Mosul secondary school in June, 1948. Competing with students from all over his country, Mishal was one of about 100 students chosen by Iraq's minister of education to come to this country to study the petroleum production option in mechanical engineering.

Before leaving for the United States Mishal was sent for a year to a preparatory school at Baghdad to master the English language, which he has managed to do. In July, 1949, he left Iraq and arrived here to enroll at Illinois.

Although he is carrying a heavy schedule this semester in order to get both his B.S. and M.S. in June of '53, he has numerous activities along with his Engineering Council work. He is a member of ASME, Pi Tau Sigma, the honorary fraternity for mechanical engi-



MISHAL HAMMODAT

neers, and is the treasurer of the Moslem Student Association.

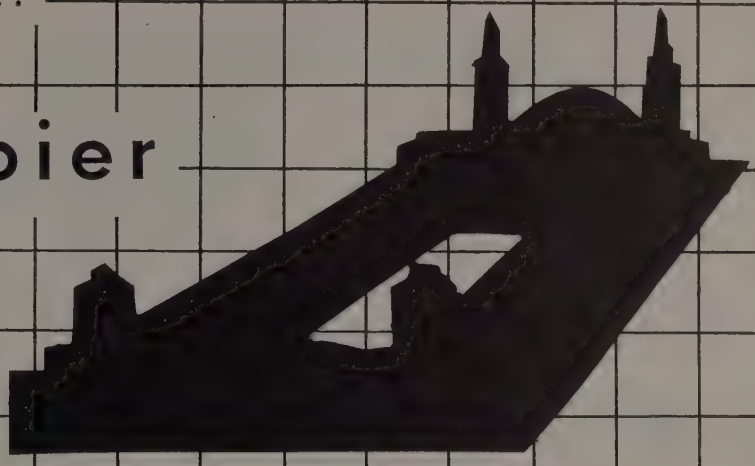
Mishal is an ardent traveler and during the holidays has visited 32 different states. He hopes to see the remaining ones before returning to Iraq. As for sports, basketball and swimming are his favorites. He is also very interested in square dancing which he picked up in this country. His taste in music leans heavily in favor of the classics.

Mishal says that the Iraq government will have spent about $15,000 on his engineering training by the time he graduates. According to his contract, he will return to Iraq after graduation to

(continued on page 32)

— *the university of illinois at . . .*

navy pier



by Melvin H. Beckman, arch.e. '55

PIER IN THE PUDDLE

The first shelter man ever had was probably the branch of a tree, hurriedly taken advantage of during the first inclement weather in the Garden of Eden. Through the history of man since that time, he has been improving on and adding to this simple shelter until we now sometimes wonder whether or not Adam's idea wasn't better than ours.

One may drive through the most exclusive neighborhoods and find house after house consisting of wildly distorted and ill-proportioned abstractions of Adam's first shelter, the tree, combined with illogical and uneconomic use of stone, brick, glass, metal, and imitations of these and other materials of nature, the use of which often depends to a large extent upon the whim of the owner.

The owner's uneducated viewpoint in architectural matters is the main reason for most of the ridiculous architecture one is forced to endure during his daily activity. Men do not dream of advising a competent doctor on the correct procedure to cure a disease. Moreover, most people listen to and heed the advice of lawyers, bankers, insurance men, and their like when their individual talents are required.

But when a man decides to build a house, does he seek the same professional advice that he would if he were about to undergo extensive surgery? Very seldom. Oh, yes, he may go to an architect, but only as a matter of necessity, since in few places can one get a permit to build without an architect's seal on the plans of a prospective structure. However, the owner comes loaded down with magazines dealing with every type of confused monstrosity he can find. He expects the architect to whip out a cute house, loaded down with the inevitable fillegre and sand drippings which have cluttered up our darling Cape Cod hovels since we can remember. No doubt this would-be home owner has a few pet ideas of his own to toss in, because after all, this magazine research he has done, he considers himself an authority on architecture and building construction.

Now, very few men get rich as architects, and as a consequence most architects will listen patiently to this man's asinine suggestions, and then provide him with the desired set of drawings, which is a combination of ideas between various feature writers, the owner's whims, the owner's friends opinions, and finally the architect's attempt at a satisfying solution. The result is obvious: an awkward, uninspired dwelling which dominates what is laughingly called our progressive civilization.

Significantly, the only homes which are truly outstanding functionally and aesthetically are being designed by men who refuse to accept these magazine-owner combines, and instead inspect the owner's problems as a new and unique situation, and then set out to give him exactly what he needs, as economically and logically as possible. Anyone who sets foot in homes designed by men like Frank Lloyd Wright, Pietro Belluschi, Walter Gropius, Bruce Goff and others of this calibre, is struck by the functional beauty of these dwellings, and anyone who has been fortunate to own or live in one will never accept anything of lower standard.

If the public would approach architects in the same way it approaches other professional men; that is, ready to listen to a logical solution of its individual problems of everyday living, they would have more pleasing and beautiful homes; even more beautiful than they realize.

Above all, through more pleasant and stimulating environments, people would live more normal and useful lives, permitting them through greater functional efficiency to devote more time and talent to restoring peaceful normalcy to the other phases of life in our disturbed, chaotic world!

ENGINEERING SOCIETIES

THE AMERICAN INSTITUTE OF CHEMICAL ENGINEERS

The American Institute of Chemical Engineers Student Chapter at the Navy Pier Branch of the University of Illinois was privileged to have Doctor Otto Eisenschmil speak to them at a recent meeting.

Doctor Eisenschmil is a well-known chemist in the field of paint chemistry, and is chairman of the board of the Scientific Oil Compounding Company of Chicago. Among his achievements are numerous articles for technical publications and several books. One of his better known works, *Without Fame*, is

(continued on page 34)

a new era in aviation . . .

Atomic Powered Aircraft

Below is the text of an address by Dr. M. C. Leverett, of General Electric's Aircraft Nuclear Propulsion Project, delivered before the Chicago Section of the Institute of the Aeronautical Sciences. Because the editors feel that this article is of such vital importance, we have included it here.

Introduction

A discussion of the interesting subject of propulsion of aircraft by nuclear power is unfortunately considerably restricted by Security. My task in making this talk is, therefore, not an easy one, and if I omit to say exactly how some of the interesting problems which I shall tell you about may be solved, it will be understood that this is unwise at present. There is, of course, the chance that in following this line I shall be credited with knowing the answers to many more problems than actually have been solved, and I hope that should you later discover that we who are working in this field have made more or less progress than you assume from my present remarks that you will not feel that I have intentionally misled you.

In spite of the restrictions placed upon our discussion we can discuss in fairly free fashion the principles underlying nuclear powered flight, some possible methods of achieving it, and some problems which are involved. Before starting this discussion, however, we should pause a moment to answer the question, "Why do we want to fly an aircraft on nuclear power?"

Many years ago Breguet set down the formula which bears his name and which states that the range of an aircraft is proportional to its lift-to-drag ratio, to the efficiency with which its propulsive system works and inversely proportional to the weight of fuel consumed per unit of work delivered to the propulsive system. Any decrease in the specific fuel consumption obviously leads to increased range. Because of the ingenuity of the designers of aircraft and engines the Breguet formula is scarcely of more than academic interest in these days. Devices such as accomplishing most of a flight slowly and using high speed only at critical times, refueling in flight, and discarding not only the fuel tanks but also the lifting surfaces which support them as soon as they are empty, all have been seriously proposed or practiced and operate greatly to increase the range of modern aircraft. However, it is no deprecation of our heavy bombers, which are the best in the world, to say that even more range would be desirable, particularly if it can be coupled with high speed. This is the point at which the nuclear propelled airplane comes into the picture. One pound of uranium-235 will liberate heat on undergoing fission equivalent to the energy liberated by burning 1,700,000 pounds of gasoline. It is at once evident that if a means can be found for converting the energy of nuclear fission into thrust that aircraft can fly for very long times on very small amounts of fuel. Indeed, fuel consumption would be measured not in thousands of pounds per hour, but in pounds per day. Because of the enormous amounts of energy available from a small amount of fuel, high efficient utilization of this energy would no longer be crucially important. Thus, specific fuel consumption could be allowed to worsen somewhat if this were desirable in order to make some other feature of the power plant easier or better.

Although the basic superiority of nuclear fuel over chemical fuel is thus superficially stated as a simple ratio of 1.7 million to 1, the implications and complications of this fact are extremely varied and far reaching. For example, some of the implications may be listed. A nuclear aircraft could encircle the globe many times without stopping, although this particular maneuver would be more dramatic than useful. It could fly entirely around the world at local midnight, accomplishing the entire circuit in darkness and with the lower vulnerability which night flying confers. Careful husbanding of fuel, programming of flight speed and altitude, and closely timed flight plans would become unnecessary in a nuclear powered airplane. Such an airplane could fly at its maximum speed and at any altitude over its operating range for all or any part of its mission and still be perfectly sure of having enough fuel to return to its home base by any route whatever. A nuclear powered aircraft could possibly stay aloft for many days. It would be limited only by the freedom of the air craft and power plant from breakdown and by the ability of the crew to endure long hours of flight and exposure to nuclear radiation. It is clear that many missions which are impossible for chemical aircraft would be possible with nuclear powered aircraft.

Principles and Suggested Methods

One of the basic principles of nuclear energy is that the energy of fission is manifested as heat. That is, a nuclear reactor is primarily a source of heat which must be converted into thrust or into mechanical work in more or less conventional ways. Hence, in any nuclear power plant whether it is for an aircraft, a naval vessel or for the generation of electricity on the ground there will be a reactor and heat machinery. In the aircraft the heat machinery is the propulsion system. Secondarily, and somewhat unpleasantly, the reactor is a source of radioactivity; hence, there will also be a shield of some type or other.

Propulsion Machinery

There is scarcely a single type of aircraft propulsion machinery which has not been proposed for incorporation in a nuclear power plant for aircraft. One obvious proposal is that propellers be used, driven by turbines which are in turn run by expanding through them vapor such as steam, heated in the reactor or air heated in the reactor. A variation of this scheme would be to extract the heat from the reactor by some liquid coolant other than the vapor or air and transferred to the vapor or air in an external heat exchanger or boiler. Another fairly obvious proposal is that the reactor should directly or indirectly take the place of the combustion chambers of a conventional turbojet engine. Here again, the heat might be extracted from the reactor directly by the air or indirectly by other coolants, such as liquid metals, and transferred to the air outside the reactor. Ducted fans driven by turbines, operated in turn by vapor or air heated in the reactor, have been suggested. Obviously, the reactor might also take the place of the combustion apparatus in a ram-jet propulsion system. It has also been proposed that a compressor-jet type of propulsion system be used, with the compressor driven by vapor or hot air

(continued on page 30)

THE FUTURE OF THE YOUNG ENGINEER at Western Electric is limited only by his own ability, by his vision to see what lies ahead and by his capacity to work for the goal he sets himself. Recent developments such as microwave radio relay networks for telephone calls and television programs – operator and customer dialing of long distance calls – automatic message accounting – new secret electronic equipment for the Armed Forces – promise an ever widening field for him.

MANY ENGINEERING TALENTS ARE REQUIRED. Most are used in creating plans, machines and technological methods to convert raw materials into thousands of different precisely manufactured articles. Here at Western, the engineer translates the stream of new designs from Bell Telephone Laboratories into terms of practical production. It is his job – a fascinating and satisfying one – to provide the ways and means of reproducing the laboratory model, as economically as possible, in whatever quantity the Bell Telephone System needs. And even after production is rolling, his efforts are unceasing in the search for improved methods, tools and materials which will result in a better product or a lower unit cost.

Western Electric

A UNIT OF THE BELL SYSTEM SINCE 1882

by Bob Schrader, ch.e. '54

OUTSTANDING SENIOR CIVILS TO RECEIVE AWARD

The annual award of the Ira O. Baker Prize given to two outstanding senior civil engineering students will be presented at a convocation on May 7.

The award was established in 1923 by Dr. Baker who served forty years as head of the UI civil engineering department. Dr. Baker, an eminent educator and engineer felt that the student who had done well scholastically, and had participated in the activities of the professional civil engineering society and on student technical publications should be rewarded in his department. He set down the following qualifications for the awards:

1. A good scholastic standing in the junior and senior years.

2. Authorship of technical articles or association editorially with the college technical journals.

3. Participation in the American Society of Civil Engineers student organization or a similar group.

4. Possession of pleasing personal characteristics, executive ability, promise of leadership, etc.

It has been the practice to invite a student of Dr. Baker as the convocation speaker, and this year Mr. A. L. Kuehn, president of the American Creosoting Company, Louisville, Kentucky, will deliver the address.

Numbered among past recipients of the award are several men now serving prominently in industry and in education as heads of civil engineering departments at various colleges throughout the United States. At the University of Illinois instructors who received the award during their student days are Robert J. Mosborg and John Ries Leek.

* * *

"A professor who comes in late is rare; in fact, he is in a class by himself."

One of the largest groups of subscribers to the *Tech* is composed of the high schools of Illinois. Along about this time of the year many seniors at these schools are thinking about college, and we hope that quite a few are interested in engineering. It is with you prospective engineering college freshmen that this section of the *Bilge* is concerned. To give you an idea of what kind of work you will be doing in engineering school, we have set down a hasty list of the courses you will be taking in engineering at Illinois.

A very large number of courses are common to almost all branches of engineering. These include a year of chemistry, a year of engineering drawing, a year of rhetoric, mathematics through integral calculus, a year of physics, some courses in theoretical and applied mechanics, and an introduction to electrical engineering.

Aeronautical engineering trains students in the basic principles of airframe and aircraft power plant design. Special study is given to aerodynamics, aircraft structures, aircraft power plants, design, and production.

Agricultural engineering includes the basic engineering courses, as well as fundamental ag courses. Two options are offered: one in machinery and power, and the other in farm structures and soil and water conservation.

Courses in ceramic engineering deal with the general scientific principles underlying the ceramic industries. These industries include the manufacture of brick, tile, pottery, glass, porcelain enamels, abrasives, and cements.

Chemical engineering prepares students to evaluate laboratory results and to translate them into large scale commercial processes, to improve existing plants, to develop new products, and to operate and supervise chemical plants.

Civil engineering offers training in the principles underlying civil design and construction. Construction, highway, hydraulics, railway, and structural options are available to civils in their senior year. A curriculum in sanitary engineering also closely parallels the civil engineering curriculum.

Electrical engineering prepares men for responsible positions in research, development, design, operation, communication and electronics, and illumination.

General engineering gives students a sound education in engineering principles with basic work in industrial organization and administration.

Mechanical engineering offers a wide variety of optional curricula in the third and fourth years. There are options in aeronautics, air conditioning and refrigeration, petroleum, power, production, design, research, and railway.

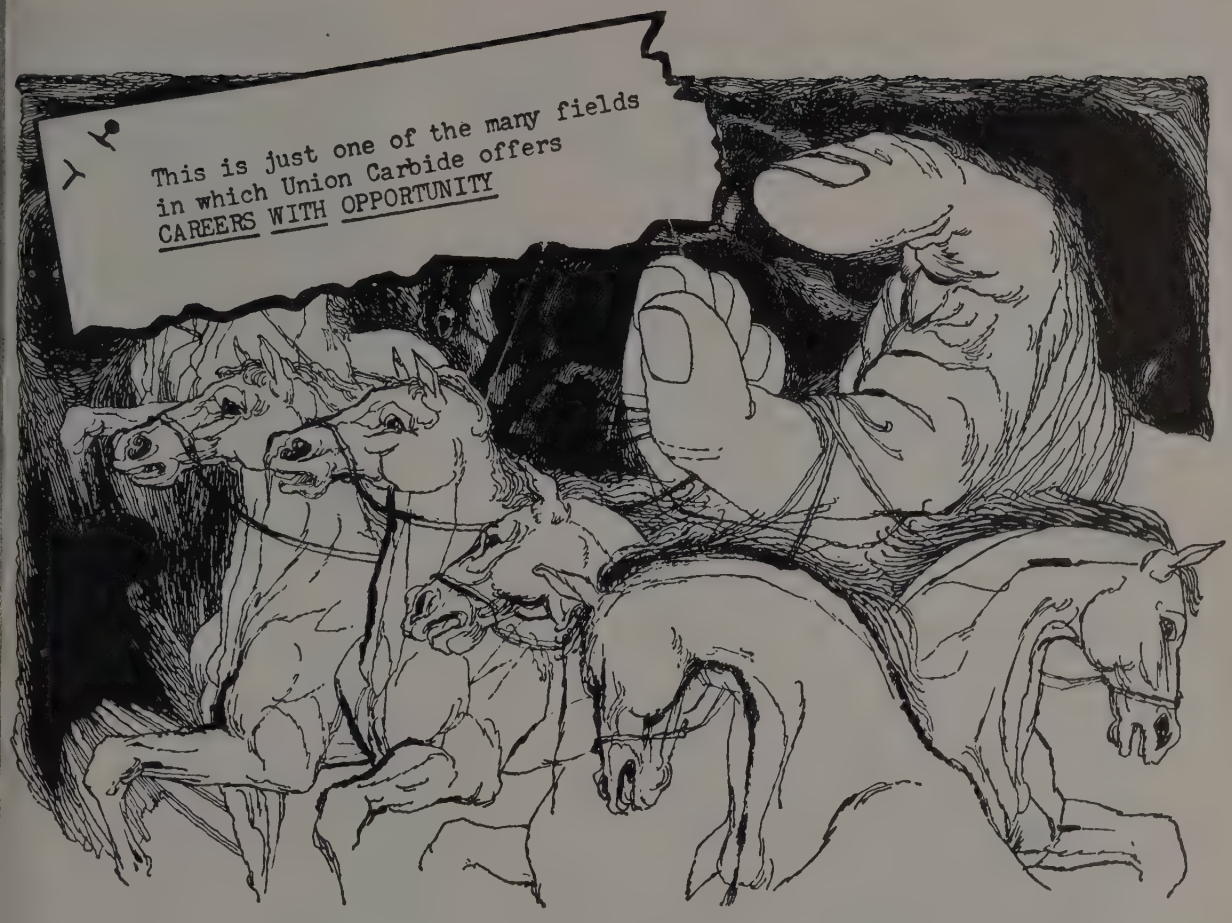
Metallurgical engineering covers chemical, physical and mechanical metallurgy, with emphasis placed on physical metallurgy.

Mining engineering gives instruction in the fundamental problems dealing with extracting coal and minerals from the earth. Specialized courses in mine surveying, mining methods, etc., are given.

The first two years of the engineering physics curriculum are much like the other engineering courses, while the third and fourth years emphasize advanced courses in physics, math, and chemistry.

* * *

The talents of engineers on this campus cover an almost unlimited range. They vary from playing football in the Rose Bowl to playing the bass viol in the University symphony orchestra. But probably one of the most versatile of the "slide-rules" is Don Sokolis, a chem engineer. Don recently paced the Illinois three rail billiard team to second place in the National Intercollegiate Billiard tourney. How about it, can you top this?



Power at your finger tip

Nearly everything you do today is done easier, quicker and better—thanks to electricity

If you are an average American worker you use the strength of nine horses each working hour of the day.

WHERE DO YOU GET SUCH POWER—Merely by flicking a switch . . . for by that simple act you are tapping the vast sources of electric energy that are ready to work for all of us in the home and on the job.

Today, the use of electric power has grown to where a single factory uses more electricity than an entire city used a generation ago. And your home—with its electric appliances, lighting and other conveniences—consumes more power than was used in yesterday's factory.

NEW MATERIALS WERE NEEDED—This great progress could not have been achieved without the many new and better materials which make possible today's larger and more efficient power generating equipment.

A JOB FOR ALLOY STEEL—Giant turbines and generators, for example, couldn't stand up under terrific heat, pressure, wear and corrosion if it weren't for steels made tough and enduring by alloying metals.

Improved plastics also do their part in better insulation and protective coatings. And carbon brushes are as vital to huge generators as they are to your vacuum cleaner motor.

FOR MORE POWER—Developing and producing alloys, plastics, carbons and many other better materials for our power industry are but a few of the many ways in which the people of Union Carbide serve all of us.

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engineers unbend at . . .

Saint Pat's Ball

by Bob Schrader, ch.e. '54

The luck of the Irish was with the Illini this year for the Engineer's Weekend. Held in the season of the year when storms are the rule, rather than the exception, the Open House was blessed with two days of perfect weather. Still following a path strewn with four leaf clovers, the engineers and their dates attended a fine St. Pat's ball on Saturday night.

The St. Pat's ball was quite a success, with engineering and liberal arts alike all enjoying the dance. Ralph Marterie and his orchestra played for the ball, and they repeated the sterling performance they had given for the Registration Dance here at Illinois last fall. Another feature of the dance was the exhibits presented by the different engineering societies. A miniature railroad bridge, the kissometer, ghost-writing, a quizzmaster for people who wanted to be stumped by the ag engineers, a display of clever gears by the mechanical engineers, and many other exhibits entertained the visitors.

Highlighting the ball were the ceremonies at intermission. Professor A. R. "Buck" Knight of electrical engineering was the master of ceremonies. He introduced St. Pat, himself, in the presence of C. Dale Greffe, associate professor of mechanical engineering. This was Greffe's second year in the role of St. Pat. Trophies then were presented to ASME for the best float in the parade and to the GED department for having the best Open House exhibit.

Dean Everitt of the college of engineering was introduced and he presented awards to the twelve men who were chosen as Knights of St. Pat. Each of the engineering societies nominates men for the honor, and the final selection of the Knights is made by the engineering council. The men selected are:

Hank Kalapaca, *The Illinois Technograph*
Bill Greenfield, IAS
John Schultz, SBACS
George Ratkovic, AIChE
Dave Harris, ASAE
Don Falk, AIEE-IRE
Jorge Quiros, MIS
Phil Trimble, AIEE-IRE
John Huber, ASAE
John Jombock, ASCE
Bob Johnson, IAS
Ralph Herrick, ASME

W. L. Everitt, dean of college of engineering, knights John Huber. (Photo by Richard Bobbe).

The high point of the intermission marked the end of a story about a door prize. The story began about two weeks before the ball when the St. Pat's committee was wondering what to give for a door prize. They finally decided to give a door. They obtained a door, painted various engineering formulas on it, and placed it in the window of the Illini Union book store.

On the Friday before the dance, a group of would-be photographers entered the book store, telling the manager that they were from the *Technograph.*

(continued on page 26)

Left: The orchestra of Ralph Marterie plays for the enjoyment of the engineers at the St. Pat's Ball. Right: Members of SDX, journalism fraternity, return "door prize" stolen from Union Bookstore window. Later the engineers returned a door taken in retalliation from The Daily Illini. (Photos by Ed Wojtas).

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ROEBLING is the best known name in wire rope. That's partly because we were the first wire rope maker in America. But more than that, we've always led in developing better wire and better rope for every purpose.

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skimming industrial headlines

edited by Charles LaRobadier, m.e. '55

New York ferries radar-equipped

Three of New York's newest ferries now feature dual console installation of marine radar equipment. Because the 290-foot vessels must operate with equal ease in either direction, each wheelhouse is equipped with a radar console alongside its wheel. The equipment, manufactured by Westinghouse, will provide a continuous chart of the entire harbor as the boats ply the heavy-traffic route between South Ferry and Staten Island, crossing the main channel through which inbound and outbound ocean traffic operates from the North and East River piers.

Both consoles will receive signals from the same antenna mounted on the top deck. Instantly adjustable, the equipment is capable of distances of one, two, four or eight nautical miles.

The 3,000-passenger ships' other features include turbine-generators, battery-charging rectifiers, Micarta plastic rudder bearings, and fluorescent lighting.

Radar-equipped New York ferry crossing harbor between South Ferry and Staten Island. (Courtesy of Westinghouse).

spring fatigue

Are your auto springs tired? It has been known for 100 years or so that steel, and all other metals, suffer fatigue if they are repeatedly put under stress. Steel can carry a big load, but when it must carry even a relatively small load time after time, it may eventually give way.

Ever since the German metallurgist, August Wohler, tested fatigue failures on railroad axles in 1852, steelmen have been looking for the secrets of endurance in steel. These secrets are very hard to get at. Just as the resistance of people to fatigue often seems unrelated to their physique, so steel's endurance seems to be largely independent of other properties of the steel.

Steelmen do know, however, that high tensile strength in a piece of steel reduces its fatigue. So they have used the things that build up tensile strength—cold rolling and heat treating—to build up steel's endurance.

Various kinds of steel are continually being worn to a frazzle in research tests, so that their limits of endurance will be accurately known before the are placed in service.

A typical specimen of steel may tak anywhere from 500,000 to 10,000,00 stretchings, or squeezings, or vibration in one experimental session—only to g through the whole process several doze more times while researchers vary th severity of the test.

It may take weeks before the endur ance limits are known, but that's stil quicker than observing a part in actua operation, such as following an activ automobile spring around—awaiting it ultimate demise upon the *n*th chuckhole

Short-wave dispatcher recording information and controlling intraplant truck shipments. (Courtesy of Westinghouse).

short wave radio truck dispatching

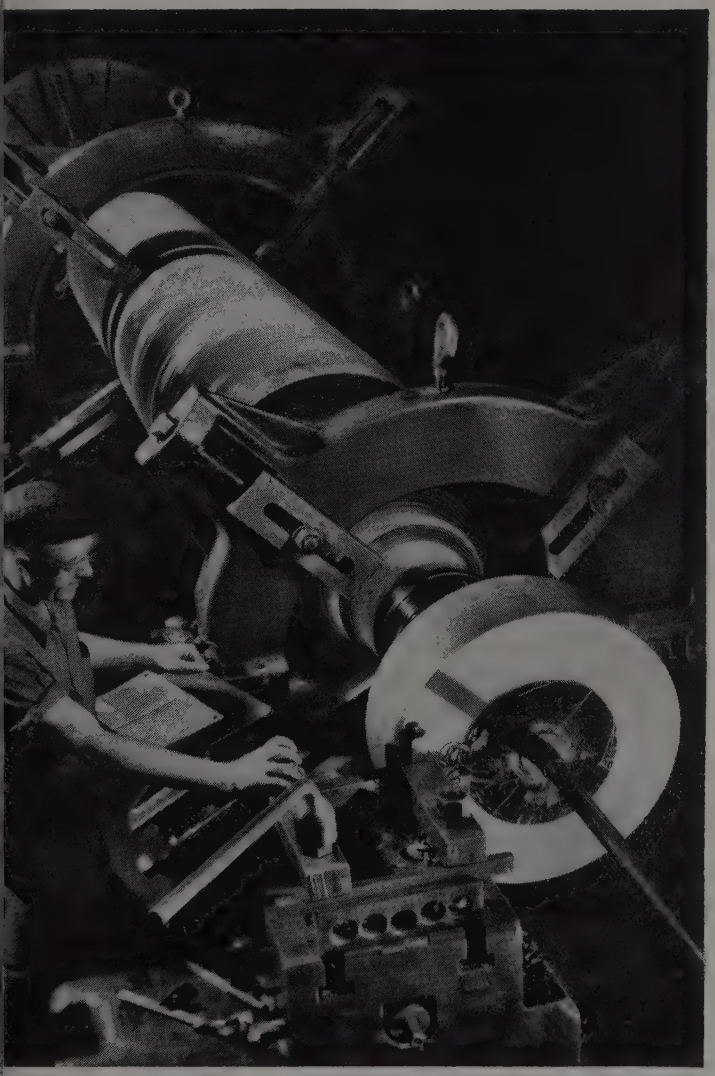
The installment of short wave set in trucks has greatly speeded up and organized intraplant shipments at Westinghouse.

From a centrally located dispatching office any industrial truck operator in the plant can be given shipment orders along with all essential information as to the most easily accessible storeroom containing the proper quantities of the materials to be moved.

One dispatcher handles the entire

(continued on page 42)

so many jobs so well



PPER. This 96-inch lathe in the Homestead District Works of U.S. Steel turn and bore a 110-ton piece of steel that's 8 feet in diameter and 66 feet ! But to produce quality forgings, it takes fine steel and skilled craftsmen, ell as modern machines. United States Steel has all three.

THE DEFENSE PROGRAM calls for steel and more steel . . . for weapons, ships, planes, even lowly barbed wire like this. Only steel can do so many jobs so well. And fortunately, United States Steel and the more than 200 other steel companies in America are able to produce enormous quantities of this vital metal . . . more than all the rest of the world put together.

'S YOU SHOULD KNOW ABOUT STEEL. In making the products that are sold under the d States Steel trade-mark, U.S. Steel buys materials from nearly 54,000 *other* companies nd over 40% of all money received by U.S. Steel for its products is paid out to these suppliers.

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GUNNISON HOMES, INC. • UNION SUPPLY COMPANY • UNITED STATES STEEL EXPORT COMPANY • UNIVERSAL ATLAS CEMENT COMPANY

BIG CATS . . .

(continued from page 9)

from the oil vapors by gravity and drops into the spent catalyst standpipe and through an automatically controlled slide valve to the air injection point. Here its density is reduced from 25 lb/cu. ft. by a current of air which "fluffs up" the catalyst making it flow as a fluid up the regenerator return line.

The oxygen in the air admitted for "fluffing up" purposes continuously regenerates the catalyst by burning off coke. This action brings the catalyst to a temperature of about 1100°F, and makes it an effective heat-transfer medium for vaporizing the fresh-oil feed and supplying the heat necessary for the cracking reaction. The reactivated hot catalyst is retained in the regenerator and is constantly withdrawn into the standpipe for re-use.

The combustion gases pass through cyclone separators in the top of the regenerator where they follow a high-velocity spiral path which throws the heavier catalyst particles to the outside of the separator by centrifugal force. The recovered catalyst is returned to the bed while the flue gases enter the regenerator exit line and pass through the flue-gas cooler where their contained heat is used to generate high-pressure steam by heat exchange with water. The cooled flue gases then pass to the electrical precipitator which has a 55,000 volt potential between plates. Most of the catalyst is recovered and the flue gases are vented to the atmosphere. Recovered catalyst passes from the precipitator into the recovered catalyst line and is blown into the regenerator.

The combined hydrocarbon gases from the spent-catalyst is recovered and returned to the main bed. The cracked gases pass through the reactor overhead line to the fractionator scrubbing section where the small quantity of resicual catalyst fines is diverted to the bottom of the fractionator and passes with heaviest oil to the slurry settler, an integral part of the fractionator in which the catalyst settles out by gravity. The clarified decanted oil is withdrawn from the top of the settler for use as fuel oil or for further processing. The thickened catalyst slurry passes into the catalyst return line and is returned to the reactor. This completes the circuit of catalyst in the system.

The vapor stream entering the fractionator passes upward from the scrubbing section through the bubble plates of the fractionator and usually is separated into wet gases, unstabilized gasoline, light gas oil, and heavy gas oil. The heavy gas oil, or the entire fractionator side stream can be diverted for a recycling operation to the recycle-oil line and so returned to the reactor for further cracking with the fresh feed, if it is economically feasible to do so.

It is hoped that some insight has been gained in the operation of this new giant of the petroleum industry. It is probable that within a few years, most gasoline used in this country will be produced by catalytic processes. With knowledge gained from experimentation and experience, the proper catalysts may be found that will produce a myriad of other products. Even now, in Brownsville, Texas, the catalytic process is being run "backward" to produce gasoline and other products from natural methane gas. Although there is no reason for doing so, even "crude" petroleum can be made from natural gas by using the proper catalysts. Catalytic processes are truly a new "magic wand" in the American petroleum industry.

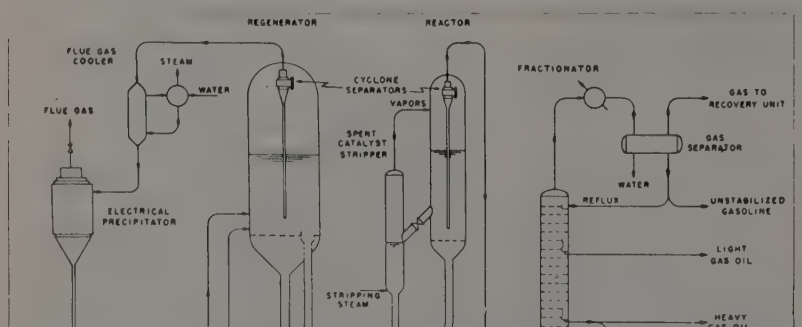


Figure 3

Courtesy M. W. Kellogg Co.

ST. PAT'S BALL . . .

(continued from page 20)

As soon as the manager turned his back, they calmly picked up the door and walked off with it.

The engineers were out after the culprits as soon as they heard about the theft, but they were too late. No trace of the door could be found. Members of Sigma Delta Chi, honorary professional journalism fraternity, were suspected of having a great deal to do with the disappearance of the door, but nothing could be proved. The question was finally settled Saturday night, as three members of Sigma Delta Chi brought the missing "door prize" to the dance. And so ends the case of the disappearing door prize.

As dancing ended at midnight, a grand Engineer's Weekend came to a close. It was a weekend that not only gave enjoyment to everyone who was here, but also established firmly once again the tradition of Engineering Open House at Illinois.

A new phase of atomic research will be opened up at the University when the department of sanitary engineering begins a study of the problem of the presence of radioactive substances in water supplies, in sewage, and in the disposal of industrial wastes.

Knowledge of these effects must be obtained before the increasing load of radioactive materials reaches alarming proportions.

* * *

Put yourself in the position of the prisoner who was given 10 white balls, 10 black balls, and 2 boxes. He was told that the executioner would draw 1 ball from 1 of the 2 boxes. If it was white, the prisoner would go free, if it was black, no head. How would you arrange the balls in the boxes to give yourself the best odds for survival? Answer next issue.

* * *

It had been a busy day for mother and to make matters worse her small son came running into the house with his pants torn.

"You go right to your room and mend those pants yourself," she ordered, "and don't let me see you out here until the job is done."

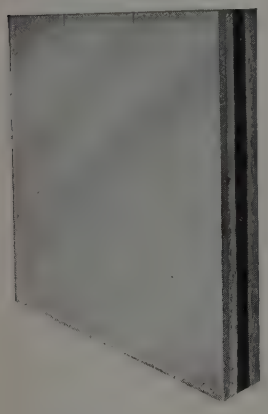
A little later she went in to see how the job was coming along. The pants lay on a chair and the door to the cellar, usually closed, was open. The mother called down sternly: "Are you running around down there without your pants on?" A deep voice answered, "No ma'am. I'm reading the gas meter."

What's Happening at CRUCIBLE

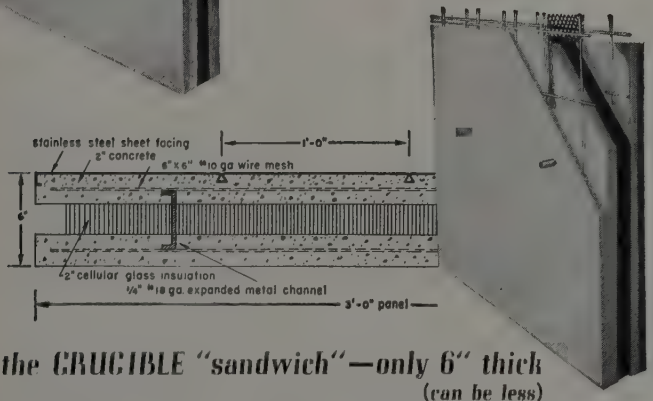
about stainless curtain walls

Modern construction methods have changed walls from the self-supporting type to a mere covering which does not support its own weight for more than one or two stories. Hence the definition of "curtain wall":—the facing or enclosure of the structural steel frame. This frame supports the entire weight of modern buildings.

The need has existed for a covering that would not only clothe the building, but be lightweight, economical and space saving. Because these requirements are more than adequately met with stainless steel curtain wall construction, this method is becoming increasingly popular with cost and space conscious owners, builders and architects.



the CRUCIBLE "sandwich"



the CRUCIBLE "sandwich"—only 6" thick
(can be less)

Crucible stainless steel curtain wall panels are in the form of 6-inch thick "sandwiches". The facing consists of flanged, light-gauge stainless steel sheets with a factory, or site-fabricated, sandwich consisting of cellular glass insulation between two layers of concrete with connecting reinforcing. Crucible 18-8 stainless as the outside face offers excellent resistance to weather and fire while providing eternal beauty with a minimum of maintenance; the inside face can be finished or painted to suit the requirements of modern building interiors. Since 18-8 is restricted in use, a good substitute material, type 430 stainless, now government decontrolled, offers the same benefits as 18-8 stainless.

moisture penetration

The unique characteristics of the cellular glass insulation stop moisture vapor migration from one face of the panel to the other. The cellular insulation properly designed and installed assures that condensation will not take place *anywhere* within the sandwich.

insulation

Although less than half as thick as the usual wall construction, this Crucible stainless steel panel construction has more than twice the insulating value. The "U" value (overall thermal conductivity) is approximately 0.15 BTU Hr./Sq.Ft./°F.

fire resistance

The Crucible sandwich met the requirements of a standard 4-hour fire test conducted in the testing laboratories of the National Bureau of Standards. This meets all old building codes and is double, or better, the requirements of modern enlightened building codes.

erection and fabrication

Since a building frame is not precision built, the attachment of the panel walls to the frame is done with fastening devices that provide necessary 3-dimensional adjustment. Panels can be made at the building site, and a 24-hour casting-to-fastening cycle is possible.

technical service available

Though the use of some stainless steel is now restricted, Crucible metallurgists and development personnel are continuing to investigate improved methods of curtain wall and other construction so that better buildings can be built when stainless is more freely available. For more information write: CRUCIBLE STEEL COMPANY OF AMERICA, General Sales and Operating Offices, Oliver Building, Pittsburgh, Penna.

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CHEM E . . .

(continued from page 11)

this that the chemical engineer translates test tube results into the working model of commercial operation.

The unit process laboratory occupies portions of the first and second floors. It also has two steel mezzanines as well as the two regular floor levels. Much of the space in this laboratory is used for projects and senior research of individual students.

The largest laboratory in the building is the unit operations laboratory. It extends from the ground floor up through the second floor. Its overall size is about 58 by 56 feet. There are three balconies at nine-foot levels, providing four operating levels. There is also a twelve-foot crane-bay. Some of the equipment in this laboratory is a six-plate distilling column, a four-plate distilling column, a double effect evaporator, an ammonia absorption column, filtration equipment, and apparatus for studying flow of fluids.

The research laboratories are constructed so that each one is next to an office. Each laboratory has two doors and emergency shower heads for the safety of the research worker. At present, a great deal of research is being done on aerosols and heat and mass transfer at high pressures.

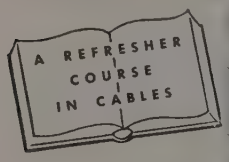
The two foremost men in chemical engineering at Illinois in the past were Professors William Albert Noyes, Senior, and Samuel Wilson Parr. While Doctor Noyes, for whom the main chemistry building was named, was a chemist, his place in the chemical engineer's history is due to his sound judgment in gathering able men to teach at Illinois. The men he brought include Doctor Roger Adams, now head of the department of chemistry, Professor W. C. Rose, and Professor C. S. Marvel, to name only a few.

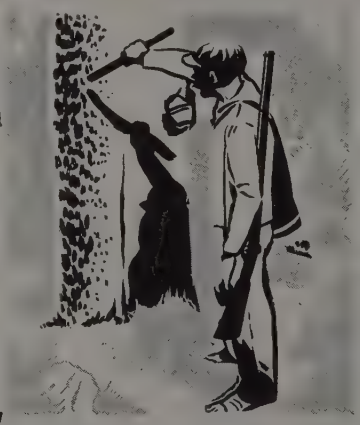
Professor Parr was the first chemical engineer at Illinois. He started the curriculum and headed the division until his retirement in 1926. He is most famous for his extensive research on Illinois coals. As a result of his work, the classification of coals has been accomplished. He contributed much important information on storing of coal, low temperature coking processes, and use of high sulfur content coals. He developed the Parr calorimeter, by which the heating value of coal is measured, and many other analytical instruments and devices used in the fuel industry. His work was not confined solely to fuels however. His contribution to boiler water treatment is still considered outstanding. He developed the non-corroding alloy Illium. It is fitting that the East Chemistry building has been dedicated to the man who did most for chemical engineering at Illinois.

If one were to look for the present head of the division of chemical engineering, he might have a hard time finding Doctor H. F. Johnstone in his office. One of the busiest men on campus, Doctor Johnstone not only teaches chemical engineering, but practices it as well. It is not uncommon for him to be in his office on Monday, in Washington on Tuesday, and back on campus again on Wednesday.

The staff, which Doctor Johnstone has gathered is of the same high caliber. Every undergraduate chemical engineering course is taught by a man with a Ph. D. While the degree itself does not make Doctors Drickamer, Peters, Ranz, and Westwater good teachers, it does indicate that they know their subject. It is also important that these men have served in industry as well as in colleges. Still these are only a few of those who help train the chemical engineer. As mentioned before, the chemical engineer needs a very good background in chemistry. For this ground-work, the chemical engineer at Illinois can thank Doctor Roger Adams and his distinguished staff.

While the chemistry student of 1868 was to be found on the baseball diamond, the chemical engineer of today is found in prominent places in the industrial world.





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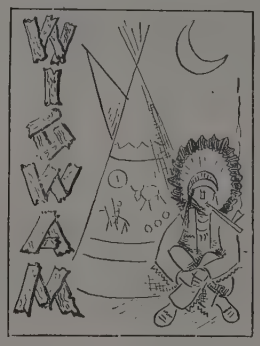

On the Campus

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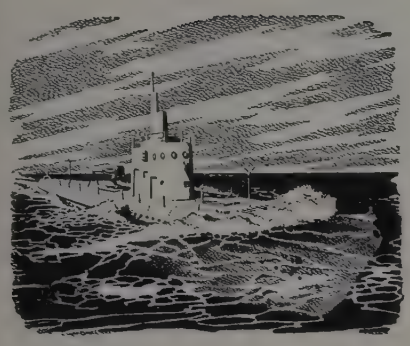

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ATOMIC AIRCRAFT . . .

(continued from page 16)

from the reactor and the heat supplied to the air by a heat exchanger through which the reactor coolant passes. In all cases, except that of the ram-jet and other direct air cycles, it is required that heat be transported in a coolant from the reactor to the propulsion machinery. In making a choice among the various types of propulsion machinery which have been suggested, the designer must perform detailed and careful analyses of many different possible combinations. Some of the problems which confront him are so obvious that they may be mentioned here. For example, if a propeller type propulsion system is chosen, the hot fluid from the reactor must be piped to the turbines which drive the propellers; these in turn must be mounted on the wings. Thus each propeller must be provided with its own reactor, or hot fluids must be piped around the airplane from a central reactor heat source. Any reactor coolant will undoubtedly become somewhat radioactive in passing through the reactor, and this alternative hence is not attractive. On the otherhand providing each propeller with its own reactor is not easy either, for two reasons. First, the weight of a reactor, with its shield, is very large; more than one reactor and shield therefore is highly undesirable from a weight standpoint. Second, two reactors per airplane would require more than twice the fuel investment of one reactor and a low fuel investment per airplane is desirable, rather than a high one.

Reactor

The design of the reactor will be greatly influenced by the coolant chosen. However, the basic principle upon which the reactor operates is the same regardless of the coolant. This principle is as follows: The reactor may be thought of as a more or less cylindrical body throughout which a fissionable material such as uranium-235 or plutonium-239 is distributed. The reactor also contains passages for the flow of the coolant through it necessary for the removal of the heat and also usually contains a material which is called a *moderator*. The reaction starts with the capture of a neutron by a nucleus of, say uranium-235. Since neutrons are present in small concentration in the atmosphere everywhere, this serves to start the reaction. Immediately after capture of the neutron the U-235 nucleus disintegrates with the liberation of two to three neutrons and 2 atomic nuclei (fission fragments) both smaller than the original nucleus. Most of the energy of fission is carried off by the fission fragments; this energy is imported to the material into which they are cast and appears as heat. Gamma rays and beta rays also are given off in the fission process.

The two to three neutrons given off are ejected into the body of the reactor any may undergo one of three different fates. 1) They may escape from the reactor entirely and be captured outside it by some parasitic nucleus in the structure of the shield or its surroundings. 2) They may be captured by some of the non-fissionable materials in the reactor itself. 3) They may be captured in another U-235 nucleus, following which additional neutrons will be given off. If we can design the reactor so that as many as about 40 per cent of the neutrons given off in fission are captured in other fissionable nuclei in such a way as to cause fission there, the reaction will continue indefinitely until the fissionable nuclei are used up.

The basic problem of reactor design is to reduce to acceptably low values the first two methods of loss of neutrons mentioned above; that is, leakage from and parasitic capture in the reactor. Leakage may be counteracted to some extent by surrounding the reactor with a neutron reflecting material which scatters but does not capture the neutrons. For example, graphite and beryllium oxide are known to be good reflectors. Excessive capture of neutrons in nonfissioning nuclei in the reactor may be avoided by eliminating from the reactor atomic species which have a strong tendency to capture neutrons or, in the language of the nuclear physicist, have a high neutron capture cross section. Unfortunately, it is not always easy to do this because some of the materials which are most suitable for use as reactor structure, and without which the reactor will not support itself, have rather high capture cross sections. These are thus poisons for the nuclear chain reaction although essential for the mechanical stability of the reactor. Obviously, we may increase the fraction of the neutrons which are absorbed in U-235 nuclei by increasing the proportion of U-235 present in the reactor. Unfortunately, this increases the amount of fissionable material invested in the reactor and since fissionable material is extremely precious it is desirable to keep its investment to a low value. We usually, therefore, resort to the device of introducing into the reactor a *moderator*. A *moderator* is an element of low atomic weight and low capture cross section for neutrons. Because of its low atomic weight a neutron striking it loses a relatively large fraction of its energy in each such collision. Because of its low capture cross section, it does not capture many of the neutrons which strike it. After the neutrons are thus slowed down or moderated, their capture by the fissionable material in the reactor becomes much more probable since the cross section for capture of low energy neutrons is higher than that for high energy neutrons. Typical moderators are graphite, ordinary water, heavy water, beryllium and beryllium oxide. The control of the chain reaction is in principle exceedingly simple. One of the most direct means of control is to arrange an absorbing rod so that it can be inserted into the reactor or withdrawn from it. If the rod is withdrawn from the reactor, it will absorb a smaller number of neutrons than before. If, in its original position, the rod was absorbing that number of neutrons which made the reactor just critical, (that is, neither rising nor falling in power) then withdrawal of the rods will create a slight excess of neutrons in the reactor and the power will begin to increase. If, for example, we withdraw the rod so that the fraction of the neutrons absorbed in fission is 0.1 per cent greater than before, then the number of neutrons in the reactor will increase by 0.1 per cent in each neutron generation. Since the neutron generation time is extremely short the reactor will build up fairly rapidly in power in an exponential manner. When it is desired to stop this build up, all that is necessary is to insert the control rod to its original position. This will deprive the neutron cycle of its 0.1 per cent excess and the power of the reactor will stay steady at the new level thus reached. Similarly, if it is desired to decrease the power of the reactor, inserting the rod more deeply than its original position will enable it to absorb more neutrons than before and the chain reaction will gradually die. Other methods of control have been proposed also. For example, in a reactor which has a reflector, removal of part of the reflector will allow the leakage of more neutrons than before. This will decrease the reactivity and constitutes a method of control. Also, removal of part of the moderator or of some of the fuel itself from the reactor will decrease the reactivity, and these expedients may also be used as control mechanisms.

It it is evident that the control of the reactor is an important matter; not so much because of the very remote possibility that the reactor might turn itself into a low grade atomic bomb, but because if the power of the reactor fluctuates without a corresponding fluctuation in the heat removal capacity of the heat transfer system, the reactor inevitably will heat up. Over-heating, if sufficiently severe, can cause accelerated corrosion, warping or even melting of parts of the reactor. Evidently too, it is important that the reactor not be operated without a flow of coolant through it since this certainly will result in seri-

(continued on page 38)

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INTRODUCING . . .

(continued from page 14)

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PROFESSOR H. F. JOHNSTONE

Professor Johnstone, professor of chemical engineering here at the University of Illinois, is the man responsible for much of the recent progress in the chemical engineering division described elsewhere in this issue of the *Tech*. A native of Georgetown, South Carolina, Dr. Johnstone attended the University of the South at Sewanee, Tennessee and received his B.S. degree there in 1923. He did his graduate work at the University of Iowa, receiving his Ph.D. degree in physical chemistry from that University in 1926.

Upon finishing his college work, Dr. Johnstone assumed a teaching position at the University of Mississippi. Two years later he moved to Champaign-Urbana and became connected with the Engineering Experiment Station at the University of Illinois. Here he entered

PROFESSOR H. F. JOHNSTONE

on a cooperative research program with the Utilities Research Commission of Chicago on a study of stack gas problems related to atmospheric pollution. In 1935, Dr. Johnstone joined the staff of the chemical engineering division and has advanced through the department until today he is head of the department.

Early in the second World War, because of the great demand for chlorine gas and the possibility of an acute shortage of electric power, Dr. Johnstone made a survey for the Office of Production Management on non-electrolytic processes for producing chlorine. Also during the war he directed a munitions development laboratory for the National Defense Research Council in which new munitions for chemical warfare were developed. In reward for this work he received the President's Certificate of Merit and the Naval Ordnance Development Award. Dr. Johnstone is now the chairman of the Research Council for the Chemical Corps Advisory Board, and scientific adviser for the Los Angeles County Air Pollution Control Board. At Illinois he also directs a contract with the Atomic Energy Commission in the Engineering Experiment Station on a fundamental study of aerosols.

Publications by Dr. Johnstone in the field of gas absorption, aerosols and fume problems, and in the production of heavy chemicals are well known throughout the chemical world. When asked about his hobbies, Dr. Johnstone replied that trips to Washington occupy most of his spare time.

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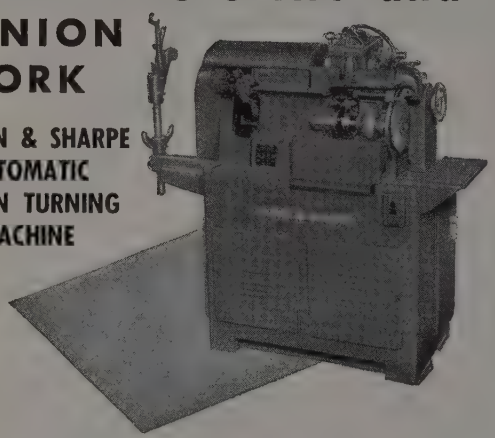

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NAVY PIER . . .

(continued from page 15)

a book in which Doctor Eisenschmil relates the highlights of 51 years as a chemist and executive. He has been very active in local organizations. Among the positions he has held are the chairmanship of the Chicago section of the American Chemical Society, the presidency of the Chicago Chemists Club, and the chairmanship of the Illinois Commission of the Purity of Paint Material.

As hobbies Doctor Eisenschmil studies criminology and philosophy and is considered an expert on the assassination of Lincoln.

After an introduction by Doctor Hunt, adviser of the Pier Chapter, Doctor Eisenschmil spoke of the problems in the research field. He outlined these problems in three steps:

1. Is the problem worth while?
2. Can the problem be solved?
3. Sell the solved problem.

He stated that there are many men with the ability to solve and sell the problem, but few who are capable of seeing a worth-while problem. Doctor Eisenschmil spoke in an informal manner and often cited incidents from his experiences. The lecture, in general, was highly informative, educational and enjoyable.

In the near future, field trips are going to be made to steel companies in the Chicago area and talks will be given by key men in the diversified fields of chemistry.

The AIChE will demonstrate the rubber-from-oil process at the University Open House which will be held April 23 and 24.

PHYSICS CLUB

During the week of March 17, the Physics Club was host to a member of the Professional Center, who gave an interesting lecture on the betatron. A week later a field trip was made to the Center to see the betatron in operation.

TALK

A general meeting consisting of mechanical, electrical and chemical engineers was held and the manager of the Chicago division of Dow Chemical Company lectured on silicones.

AIEE

On March 4, the chapter was host to a Bell Telephone demonstration of microwaves and later in the month on March 18, Dean F. W. Trezise spoke on *The Manpower Shortage.* April 1 will start off with a movie on the *Electrical Proving Ground,* and on April 29, a field trip to Commonwealth Edison Company to see a demonstration of their circuit analyzer.

AIA

The AIA under a new regime has started a new policy. Ray Bulinski, president of the student chapter, introduced the new system of business meetings on every other meeting and visiting lectures and educational events on the other occasions. A close tie between the student and professional chapters has made this possible. Mr. Harold Reynolds, AIA architect, specializing in interior decorating, delivered the first lecture of the semester on interior decorating.

* * *

On April 23 and 24, from 5 p.m. to 9:30 p.m., the Navy Pier Branch of the University of Illinois will throw open its doors to the public for the 1952 Open House. Everyone is welcome.

A prof of ours went to see the dean and asked him for the day off to celebrate his silver wedding anniversary.

The dean, after some deliberation, said, "All right, but I hope that I'm not going to have to put up with this every 25 years."

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ATOMIC AIRCRAFT . . .

(continued from page 30)

ous damage if not destruction of the reactor.

Shield

Although most of the energy of nuclear fission appears as kinetic energy of the two fission fragments mentioned above, and this kinetic energy in turn appears as heat in the fuel elements, a substantial portion of the energy of a reactor appears as kinetic energy of the neutrons and as ionizing radiation, such as gamma rays and beta rays. The neutrons and gamma rays, if allowed to escape with complete freedom from the reactor, would make it necessary for human beings to stay at a distance of more than a mile from a high powered reactor while in operation. Moreover, since the fission products themselves are radioactive and continue to emit gamma rays even after the chain reaction has been stopped, it would not be possible to approach the reactor very much closer than this even after it had been shut down. It is clear that a *shield* must be provided.

The basic requirements of the shield are dictated by the two basic types of radiation which it is desired to stop. The neutrons are slowed down most effectively by light atoms such as hydrogen, and moreover are more easily captured after being slowed down. For this reason an effective shield will contain light atoms such as hydrogen, which also is a good slow neutron absorber. Gamma rays, on the otherhand, are degraded in energy and stopped best by heavy elements such as lead. Hence, the shield normally will contain heavy elements also. It is clear that a mixture of light and heavy elements arranged in the most strategic fashion will be desired. The details of this arrangement are not particularly important for a large stationary reactor such as those which have been built on the ground in the past. However, for a reactor which is to be mobile it is important that the shield weight and dimensions be kept small. Hence, the materials put into the shield must be the best possible and must be arranged in the best possible fashion. The detailed solution of this problem is extremely complicated.

Another point of importance is that not only must the shield prevent escape of radiation from the reactor to the desired degree but also it must be capable of admitting and emitting the coolant which carries the heat away from the reactor. This means that ducts must pierce the shield and we are then confronted with the problem of leakage of radiation through these ducts. Generally speaking, gamma rays and neutrons travel in straight lines. However, under certain conditions they can be scattered or reflected around corners or curves. This confronts us with another difficult but interesting problem in the shield.

Some Problems of Nuclear Powered Aircraft

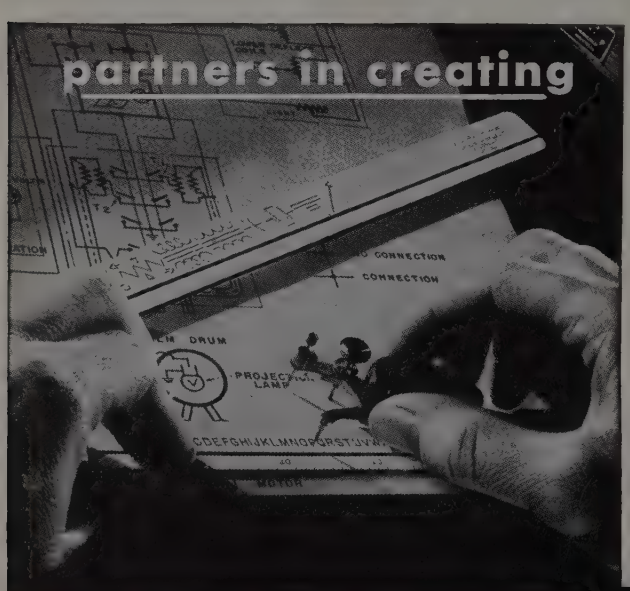
It may be interesting to pose some difficult problems in addition to those mentioned above which confront the designer of a nuclear powered aircraft.

The shield will be the heaviest single object aboard the aircraft. Early published estimates of shield weight placed the minimum at 50 to 100 tons, without any provisions for removal of heat. From this it is evident that a large aircraft will be required to carry a weight of this magnitude even though the aircraft need carry little or no chemical fuel. To a first approximation one may balance off the weight of the shield against the weight of the fuel load which would be carried in the large modern aircraft, since the shield and the reactor which it contains essentially replace the fuel load. The fuel loads of modern aircraft range up to the neighborhood of 75 tons or more. If the early estimates of shield weight referred to above are anywhere near correct, it is evident that the weight of the shield plus the reactor is not grossly different than that of the fuel which can be carried in a large conventional aircraft. However, every effort must be made to keep down the weight of the shield and the reactor. One obvious way to do this is to make the reactor small so that the shielded volume is kept small. This in turn restricts the amount of cross sectional free flow area through which coolant may pass through the reactor and increases the pressure drop. Moreover, as the reactor diameter decreases it usually is found that more fissionable material is required. This is undesirable. There is therefore a balance to be struck between the benefit of small shield weights resulting from decreased reactor size on the one hand, and the disadvantages resulting therefrom in smaller free flow area for coolant flow and larger fissionable material investment required.

Balance and Structure

The existence of a large concentrated weight such as the shield and the reactor at one point in an aircraft, makes it necessary to redesign the structure of the aircraft to accommodate this weight. Although large aircraft are designed for very large gross weights this weight is usually distributed over the wing and throughout the fuselage. Concentrating the weight in the fuselage greatly increases wing bending

(continued on page 40)



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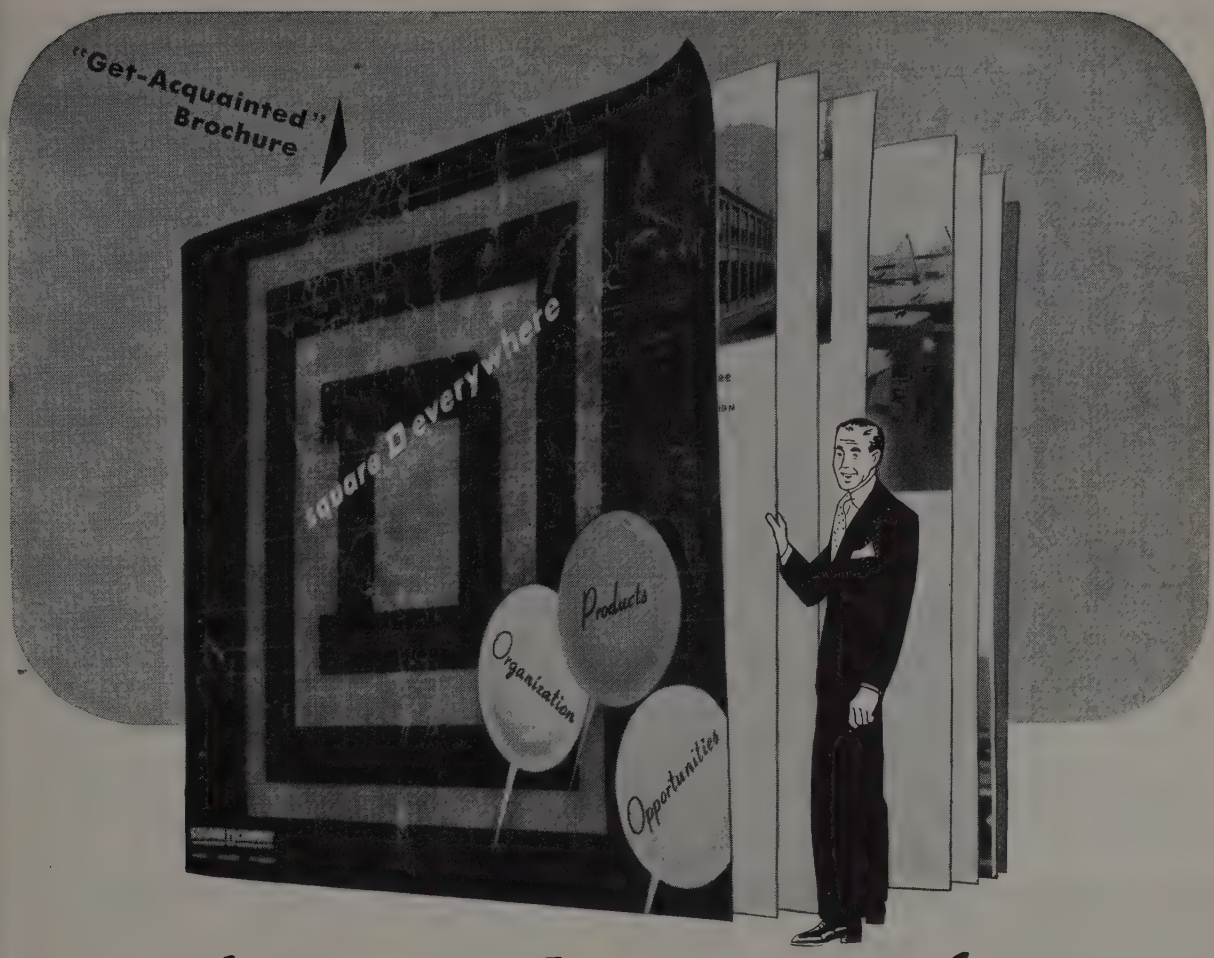

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ATOMIC AIRCRAFT . . .

(continued from page 38)

moments and necessitates structural redesign in many cases.

Large Landing Weight

The very fact that only a small amount of the fuel is consumed in flight means that the gross weight of a nuclear aircraft will be approximately the same on landing as on take-off. First, the landing gear must be made strong enough to take the higher gross landing weight. Second, the landing speed is increased and there may be a change in landing attitude which possibly could require changes in the landing gear, or in tail clearance angle requirements.

Heat Transfer

The very essence of a nuclear power plant is the transfer of heat from the reactor to the propulsion machinery. The requirements for small size and high power density placed upon the aircraft reactor push the heat transfer designer to the limit of his knowledge. He must avoid hot spots in the flow system, he must have good flow distribution and he must know exactly how the power is distributed in the reactor so that he can supply the right amount of coolant to each part of it. Solution of these problems requires a great deal of detailed analysis and experiment. For example, consider the cooling of a surface beneath which U-235 is located in a reactor. The rate of heat generation is independent of the local temperature, thus if the surface be deprived of its coolant it will at once rise in temperature until it melts or disintegrates. The reactor is like a heat exchanger to which heat is constantly supplied whether it is taken away or not; only by maintaining the flow of coolant can trouble be avoided.

Fissionable Material Investment

The desirability of keeping the quantity of fissionable material in the reactor small, has been mentioned previously. It is obvious that this is desirable. However, the chain reaction will go in the reactor only so long as there is present a certain minimum quantity of fissionable material called the critical mass. As soon as the reaction has consumed so much fissionable material that the mass drops very slightly below the critical mass, the chain reaction dies and cannot be started again without adding more fissionable material. Moreover, the products of fission remain in place in the fuel elements and eventually must be removed. This makes it necessary to remove the remaining fuel from the reactor, purify it and prepare it for reuse. The amount of uranium which may be tied up in the reprocessing activities may easily exceed that which is tied up in the reactor proper. Thus, the uranium investment is not simply the amount of uranium carried aboard the aircraft but also that which is on the ground in various stages of preparation for use. The question of recovery and reprocessing of the fissionable material is a matter for the chemist and chemical engineer, and is a whole new subject on which I shall not touch further here.

Radiation Damage

Inter-nuclear collision between neutrons and the nuclei of materials used as structures or as moderators in the reactor or between fission fragments and other nuclei result in dislocation of the nuclei with which collision occurs. While it is definitely known how great an effect these dislocations have it is known that the properties of the materials in which they have occurred undergo a change. Usually this change is in a detrimental direction. For example, a decrease in thermal conductivity may occur, thus making the heat removal problem ever harder. Or, other equally critical properties may deteriorate.

Some liquids or gases which might be proposed as reactor coolants are decomposed by radiation, and are hence not usable. Organic compounds are parti-

(continued on page 44)

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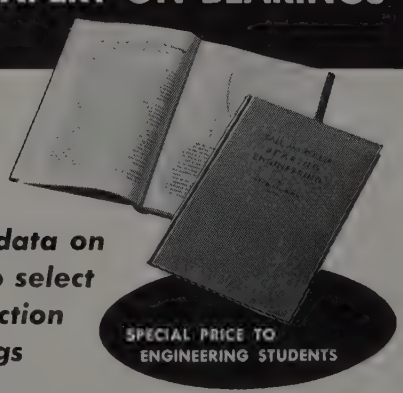

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TECHNOGRAPH

THE DU PONT DIGEST

Thurman W. Kaiser *(at right), B.S.Ch.E., Purdue '50, supervises tests of improved process for making neoprene intermediates.*

Ch. E's at Du Pont

[FOURTH OF A SERIES]

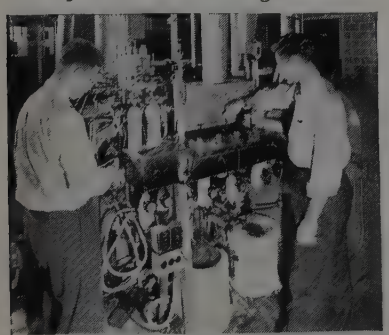
Plant development work is solid background for a future in chemical engineering

The work of production supervisors at Du Pont, as discussed here last month, is aimed at getting better results from existing processes and equipment.

In contrast, the job of plant development groups is to find ways to improve methods and products, and advise management when changes should be made for economic or technical reasons. Chemical engineers in this work are responsible for lowering process costs, adapting the product to new uses and improving product quality to obtain a larger share of the existing market.

These duties provide an understanding of the fundamental aspects of the business, as well as a broad view of Company operations. The training and experience a man gains as a member of a plant development group—often a first assignment at Du Pont—is an excellent background for any field he may move into later.

Conducting a development study usually involves obtaining data from laboratory, semi-works and plant-scale experiments, estimating profits and investments, and consulting with sales, research and production personnel, also with auxiliary departments such as Engineering, Chemical and Purchasing, and with outside authorities.



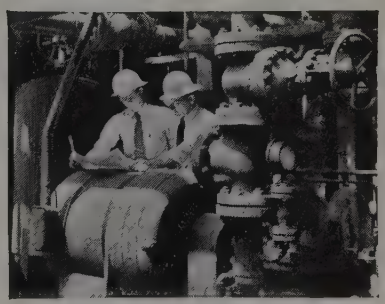
H. E. Graham, Jr., *B.S.Ch.E., Georgia I. T. '48, and J. F. Carley, Ph.D.Ch.E., Cornell '51, study a plastic compounder-extractor-extruder for improvements in making plastics.*

Here are typical problems solved by plant development groups:

John Purdom, *B.S.Ch.E., Ohio State '49, and Kenneth Kehr, B.S.M.E., North Carolina State '50, discuss diagram of a process for improved recovery of a nylon intermediate.*

1. Prompted by obsolescence and wearing of equipment, experimental studies and economic comparisons were made on the entire process of isolating dyes. Methods in use called for crystallization, filter pressing and tray drying. It was found that a rotary vacuum filter with a continuous rotary steam tube dryer, air conveyor and a dust collection system reduced costs about $50,000 a year.

2. Production of sodium silicate was to be increased substantially, but the tank-type furnace at the heart of the process proved a bottleneck. The furnace design, including exit and entry ports, was improved, and its capacity enlarged at a small fraction of the cost of a new furnace.



Reid Earnhardt, *B.S.M.E., Cornell '44, M.S.M.E., Carnegie '48, and René M. LeClare, M.S.Ch.E., M. I. T. '51, check installation of improvements in plant equipment.*

With the rapid growth of technological improvements all over the world and increasing competition, plant development work assumes greater and greater status. The Ch. E. entering such a group at Du Pont finds a wealth of opportunity for his skill and ingenuity.

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SKIMMING . . .

(continued from page 22)

fleet of trucks and records information received from a truck operator on his master materials location sheet. This record is being continuously compiled by the dispatcher from truck-operators' call-in reports so that he has the latest record of both material locations and quantities at these points.

Essentially, the regularly licensed installation is very similar to a taxi dispatching system.

no support for melting metals

In a nearly incredible experiment at Westinghouse recently, aluminum was melted by placing it between two horizontal coils of copper a few inches apart and applying energy at 10,000 cycles. As the switch was closed the aluminum actually floated into space between the two coils. It began to spin rapidly, glow red, soften, and turn to a liquid, assuming, as it did so, the shape of a spinning toy top. When the power was shut off the melt dropped to a crucible below where it instantly solidified.

This was the outcome of efforts to produce more nearly pure metals. When high-temperature metals are melted in a crucible, reactions occur with the refractory. But in the case where the metal is melted in air where volatile impurities are lost and other impurities are not picked up, greater purity is achieved. Alloys can also be produced while the metal is suspended. The induced currents automatically produce the necessary stirring.

Melting aluminum in air produces purer metals and alloys. (Courtesy of Westinghouse).

Although still limited in choice and quantity of metals, this process has been successfully employed in research for metals in lamps, electronic tubes, and other high-temperature applications particularly where it is not necessary to greatly exceed the melting point of the metal.

crash trucks for air force

Details were recently released on the nature of several hundred crash and fire-fighting trucks to be built for the U.S. Air Force by Marmon-Herrington Co.

Known as Model 0-10, the new trucks are designed to operate efficiently in any temperature ranging from 65 degrees below zero to 165 degrees above, Fahrenheit. This extreme range necessitates, among other things, a completely automatic generating system to keep batteries charged at all times as well as an auxiliary heating system for engines.

The 0-10 is a high-speed vehicle used to reach crash scenes as quickly as possible. Featuring six-wheel drive, the new truck has maximum traction and can go through deep mud, sand and snow and up steep grades with amazing speed and ease.

Because of unique design, the Model 0-10 is able to close in on a crashed

(continued on page 46)

PRATT & WHITNEY AIRCRAFT, leading aircraft engine designer and manufacturer has been a firm advocate of "creative engineering" for all of its 27 years in business. Operating as it does in a highly technical field, the company has never veered from the basic policy that engineering excellence is the key to success.

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Such an approach has enabled Pratt & Whitney to gain a top reputation for piston and jet engine development. Only recently the company became one of the few in the country to be awarded a U. S. Government contract for the development of a nuclear powered aircraft engine.

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THE STRIKING HEAD of this common kitchen match contains sulfur. It symbolizes the host of everyday items that would be affected by a severe sulfur shortage. Sulfur finds its way into almost every branch of American industry. It is important to the production of chemicals, fertilizers, petroleum products, and numberless other materials vital to the nation's defense program and to our normal industrial and economic development.

How the Petroleum Industry helped ease the Nation's Sulfur shortage

THERE IS A SAYING, "the best index of the level of the civilization of a country is its production of sulfuric acid." The U. S. would have had real cause to worry had the critical shortage of sulfur in the past 18 months gone unchecked.

However, since sulfur in the form of hydrogen sulfide occurs in natural and refinery gases, the petroleum industry took the impending shortage as its cue to step up its normally limited recovery of sulfur from these sources.

Accordingly, by mid-1952 recovery from petroleum and natural gas will have mounted to 700,000 long tons per year. This will provide substantial help in relieving the national shortage. Since this tonnage is considerably above the needs of the oil industry, it will ease the situation for many other industrial users.

Standard Oil has taken the lead in the midwest in this by-product sulfur recovery program. With facilities at Whiting and in the far west and south west, the company will produce nearly 10% of the sulfur obtained from petroleum sources.

Sulfur recovery and Standard Oil's part in it is just one example of how young men with training in chemistry and engineering may apply their skills and knowledge in our company—and gain deep satisfaction in the results of their work.

Standard Oil Company

910 South Michigan Avenue, Chicago 80, Illinois

STANDARD

ATOMIC AIRCRAFT . . .

(continued from page 40)

cularly susceptible, and even outside the zone of most intense radiation in the reactor ordinary lubricants turn tarry or even solidfy. Lubricated machinery hence may not be used in such locations. Electrical insulation, on prolonged exposure to radiation, breaks down and disintegrates or loses its effectiveness.

There is here a large field of investigation, particularly in the physics of solids, where much work must be done in order to elucidate the effects of radiation damage, as this phenomenon is called, on the materials which might be used in an aircraft reactor, or in radiation exposed locations in the shield.

Escape of Radioactivity

It is evidently necessary to confine substantially all the radioactivity of the reactor within it. This imposes on the designer of the reactor another restriction. It is occasionally suggested that a nuclear aircraft will create a hazard to population in its vicinity. Inasmuch as the aircraft itself will carry a crew which must be protected adequately, persons at a distance will not be affected in any way.

Materials

One of the most important problems in reactor technology today is the finding and development of materials adequate for use in reactors which are proposed for production of power in one form or another. The combined effects of high temperature, corrosion by various coolants, radiation damage, thermal stresses, and mechanical stresses can be extremely serious in some cases. The aircraft reactor presents these problems to an unusual and critical degree. For example, a difference of 100° F in permissable maximum reactor temperature can easily produce a 15 per cent difference in thrust output of the power plant. High temperature materials are therefore a prime necessity. A corrosion resistant coating on the reactor heat transfer surfaces a few thousandths inches thick may double the critical mass. A brazing alloy containing a few per cent boron (a strong neutron absorber) may put so much boron into the reactor that it cannot be made to go critical, and this particular alloy may therefore be entirely un-usable. An alloy high in nickel may have good corrosion and high temperature strength properties for use as reactor structure, but be so strong a neutron absorber as to be substituted by another alloy of lower nickel content and poorer corrosion and strength properties. The finding of materials adequate to withstand these conditions is a challenge worthy of the best metallurgist, ceramist or chemist.

Outlook

In many respects the propulsion of aircraft is an ideal use for nuclear energy. Here to a higher extent than in any other application the advantages of a highly concentrated source of heat can be used to good result. Although the goal of producing a nuclear powered aircraft is an admittedly ambitious one it is only such high performance, premium uses of energy which can today justify the consumption of as rare a resource as uranium-235 or plutonium-239. Moreover, it is inescapable that a development of this type has great military significance.

In recent months the government has announced that the nuclear aircraft program is entering a new phase. In this new phase the Aircraft Gas Turbine Department of the General Electric Company has been given the responsibility for the propulsion system and the Consolidated Vultee Aircraft Corporation is to supply an airframe.

My belief is that our efforts to fly an aircraft on nuclear power will be successful. The difficulty of the task and the value of the result combine to form a challenge which is in my opinion unmatched.

And then there was the deaf mute that fell into the well and broke three fingers screaming for help.

NEW PLANT MAKING AGRICULTURAL AMMONIA USES FRICK REFRIGERATION

The Mississippi Chemical Corp. at Yazoo City uses three Frick compressors to hold 2,000 tons of liquid ammonia in the spherical tanks (at upper right) by reducing the pressure and temperature.

This eight-million-dollar plant, built by 10,000 stock-holding farmers, produces both liquid ammonia and solid ammonium nitrate for use as fertilizer.

Installation by Munford Engineering Co., Frick Distributors at Jackson.

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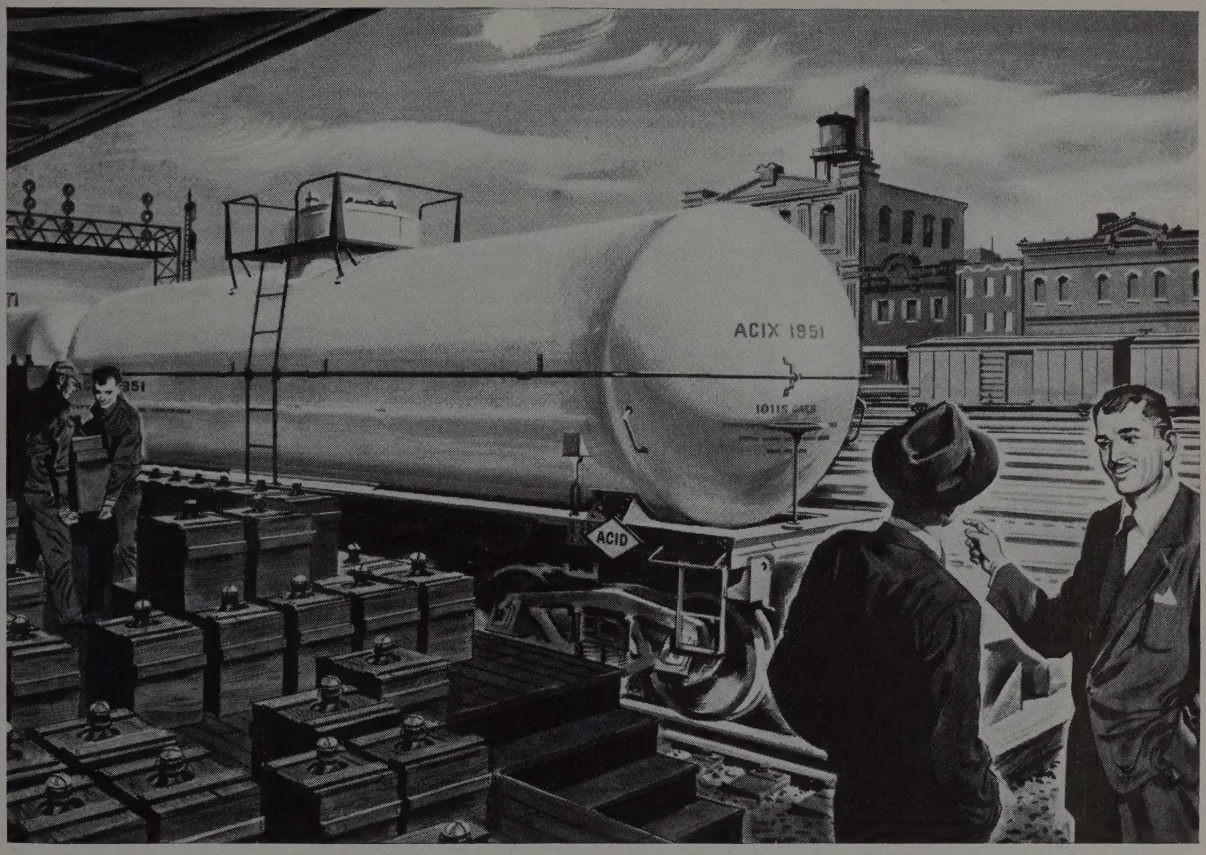

This car replaced 615 "Bottles"

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In 1927, a chemical manufacturer asked us, "Why must some chemicals be handled in small drums or carboys . . . can't tank cars be built of aluminum?"

From our years of research, we knew that we had alloys compatible with many chemicals—and experience in fabrication methods dictated welding. The Field was inviting, and we decided to design and pay for the first aluminum tank car ourselves.

Our engineers designed an 8,000-gallon tank, to be welded together from 16 large aluminum plates. Working with a leading tank car builder, lessons which we had learned in other Alcoa developments enabled us to materially assist in the alloys selected, welding techniques and structural fabrication methods employed. One year later, in 1928, the car was completed. It was then tested in 20,000 miles of road service, while hauling glacial acetic acid—a typically tricky cargo. It weathered 3,500 recorded shocks—900 severe ones. That aluminum car is still in service!

Together with tank car builders, we have developed improved riveted and welded car designs, which are now "standard." Today there are over 1,300 aluminum tank cars carrying the fussy compounds that formerly traveled only in small containers.

This is typical of the development jobs we do at Alcoa. Others are under way now and more are waiting for mechanical, metallurgical, electrical, chemical and industrial engineers having the imagineering skill to tackle them. Perhaps you may be one of those men. ALUMINUM COMPANY OF AMERICA, 1825 Gulf Building, Pittsburgh 19, Pa.

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A business built on co-operation

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ALUMINUM COMPANY OF AMERICA

SKIMMING . . .

(continued from page 42)

plane, drive the fire away from the crew compartment and permit rescue even before the fire is totally out. This is accomplished by a cab-controlled air-foam turret nozzles in conjunction with powerful ground sweep sprays. The delivery pressure for the major extinguishing agents is derived from a pump driven by a separate engine which is carried amidships.

an atomic yardstick

Atomic radiation may someday be harnessed as the most accurate measuring devices, according to I. F. Kinnard, manager of engineering for GE and leading authority on measurements.

Speaking on future instrument design and engineering trends, he said that "the potentialities of atomic radiation in the field of measurements are boundless." As an example of how radiation could be used as a "measuring stick," he explained, "would be to direct the rays into a container of liquid. On striking the liquid, the rays would be so affected that when measured they would indicate the exact amount in the container."

However, before such steps are taken, new instruments to measure radiation itself must be developed. These instruments would have to meet requirements much higher than present-day needs if the atomic power is to be used to generate electricity, or to run ships and aircraft.

"Great strides will be taken in the development of new instruments," he predicted, "to assume the most efficient and reliable operation of atomic power plants. This development work must be given important priority, so that new applications of atomic energy are not delayed."

He also warned that research in this field would involve nuclear physics, "a little-tapped field in the measurements industry."

new dentifrice uses glycerine

According to the makers of a new dental preparation, glycerine has solved the dentist's problem of pastes which splash and spatter when used for cleaning teeth with mechanical equipment. The product is made solely for professional use, and it is one of the first of such compounds to be made available in ammoniated form. The doctors who developed it explain that glycerine was the only binder they found which provided all the qualities they desired, including the non-spattering property.

Chief ingredients are dibasic ammoniated phosphate, carbamide, a synthetic detergent, and pumice, which are held together by glycerine to form a smooth past which does not separate or dry out. Glycerine's plasticizing effect and the good consistency it imparts allow the paste to be used without water, which accounts for the absence of spattering when it is applied by mechanical means. Glycerine is also said to help preserve the high ammonia content during shelf life.

atom-smasher x-ray for cancer treatment

An atom-smasher that develops the most powerful X-ray beam ever generated specifically for the treatment of cancer is now being assembled at the University of California School of Medicine, San Francisco.

The machine is a synchrotron that produces an X-ray beam of 70,000,000 volts. With it, University of California scientists will do some pioneering research on the possibility that ultra-high energy X-rays have some advantages in treating deep-seated cancer.

The synchrotron, purchased with funds from the Atomic Energy Commission, has just arrived in San Francisco. It was designed and constructed at Schenectady, N. Y., by GE scientists and engineers.

The new cancer-fighting weapon is being reassembled in a two story building constructed especially to house it and its associated laboratory. Total cost of the machine and the building, all financed by AEC funds, is about half a million dollars.

Dr. Robert S. Stone, professor of radiology and one of the pioneers in the application of nuclear physics in medicine, is the director of the project.

Dr. Gail Adams, physicist in charge of the operation of the machine, came to the School of Medicine from the University of Illinois, where he played an important role in the development of the 20,000,000 electron volt betatron, presently the most powerful X-ray weapon used in cancer treatment.

Work with the 20,000,000 volt betatron indicates it is possible to put a higher dose of radiation in deep-seated tumors than with lower voltage machines. At 70,000,000 volts this effect may be even more pronounced. Due to the flexibility of the machine it can be adjusted between 20,000,000 and 70,000,000 volts.

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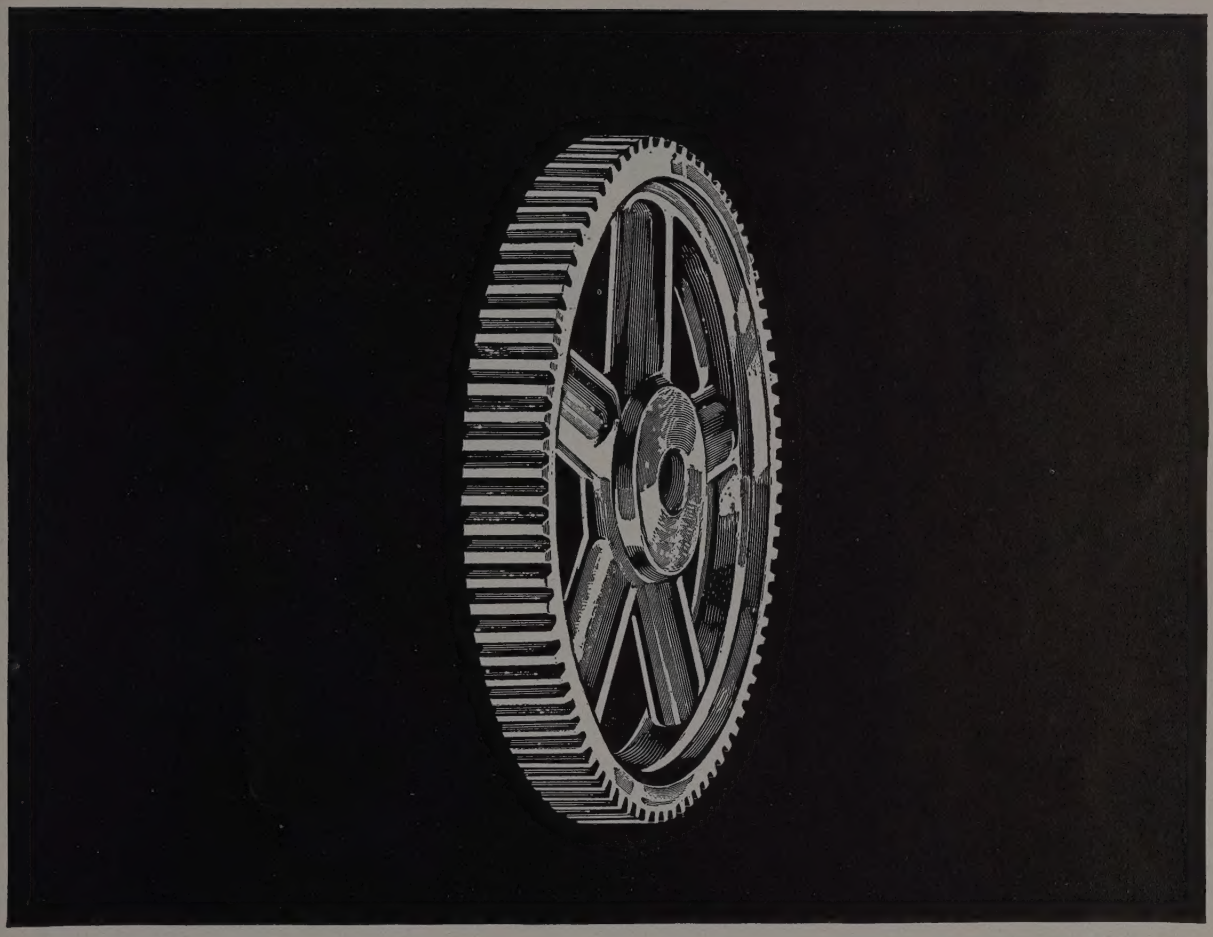
Army Doctor: "Now look here, my good man. You know very well you wouldn't come to me in civilian life with a thing like this."

Recruit: "Of course I wouldn't. I'd send for you!"



ANCESTRY UNKNOWN . . .

No one knows who first thought of gears as a means of transmitting power or motion . . . but without them modern civilization could not function.

There would be no clocks, cars or calculators . . . industry would revert to hand production . . . transportation would go back to the horse and buggy . . . household chores would multiply . . . office managers would be seeking mathematical geniuses.

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A gear never works alone. Only when properly meshed can it function efficiently. So, in industry, minds must mesh if progress is to result. Here, in America, engineers, inventors, machinists, toolmakers are geared for great advancement. And their point of contact is America's all-seeing, all-hearing and reporting Inter-Communications System.

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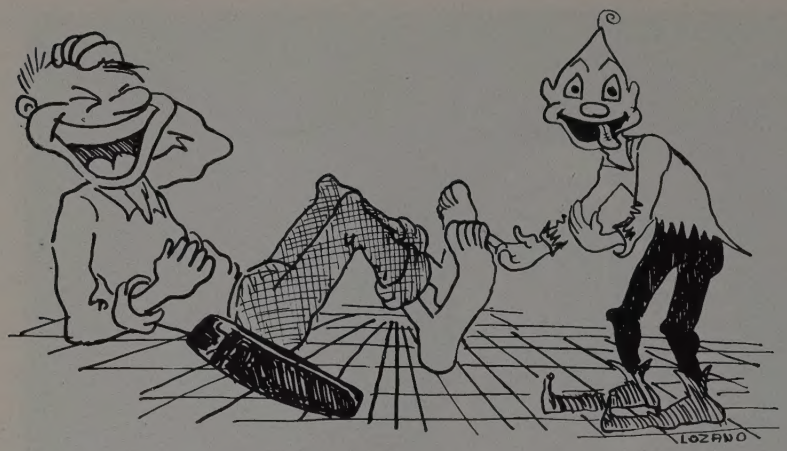

TECHNOCRACKS

edited by Pete Cattapan, gen.e. '53

Child specialist to mother of small boy: "You'll have to handle this child carefully. Remember, you're dealing with a sensitive, high-strung little stinker."

* * *

Report of tardiness to 8:00 classes: A body in the sack tends to remain in the sack. The cohesive force between the body and the sack varies as the square of the time the body is in contact with the sack.

* * *

Math Prof.: "Give me an example of an imaginary spheroid."

Engineer: "A rooster's egg."

* * *

A local policeman stopped his squad car and hailed an inebriated gentleman who was making his dubious way down the street.

"Hey you," he shouted, "where are you going in that condition?"

"Gonna work," mumbled the drunk.

"Oh yeah," growled the officer, "what kind of work can you do in the shape you're in?"

"Minin."

"Minin what?" persisted the cop.

"Minin' my own damn business," snapped the drunk, "and why don't you do the same?"

* * *

Engineering Student: "Do you serve crabs here?"

Bidwell's Waitress: "We serve anyone."

* * *

Lo and behold, engineering has invaded South Campus. "Fire," the play which won first prize in the Contemporary Arts Festival, was written by Arthur Gregor, an electrical engineer living in New York City. The play will be given during the first part of April.

An elderly woman visiting the zoo wanted to ride a camel. The keeper hoisted her up, but was unable to make the camel move.

At last the lady dismounted and started to pet it. Suddenly it went running off as fast as it could. The keeper turned to the old lady.

"Madam," he said, "what did you do to him?"

"I tickled him," she replied.

"Well," said the keeper, "you'd better tickle me. I've got to catch him."

* * *

Suggested slogan for parents with kids in college: "The Dough must go on."

* * *

It's possible some of those gangsters meant, "I refuse to answer on the grounds it may incinerate me."

* * *

Clerk: "Did you kill any moths with those moth balls I sold you the other day?"

Customer: "No, tried for five hours, but I couldn't hit one."

* * *

Newcomer to Champaign: "How does the land lie around here?"

Old-time Resident: "It isn't the land that lies. It's the real estate agents."

* * *

"Is there anyone present who wishes the prayers of the congregation for a relative or friend?" asked the minister of the little New England church.

"I do," said an angular lady arising from the rear pew. "I want the congregation to pray for my husband."

"Why, sister Abigail," replied the minister. "You have no husband as yet."

"Yes, that's why I want you all to pitch in and pray for one for me."

The excited voice of a young Smith girl came over the phone: "Two boys are trying to break into my room through the window!"

"Listen, lady, this isn't police headquarters; this is the fire department."

"I know," she answered, "but my room is on the second floor and they need a ladder."

* * *

Recently the following testimony was received by a patent medicine concern:

"For nine years I was totally deaf, and after using your ear salve for only ten days I heard from my brother in South Dakota."

* * *

She: "Time separates the best of friends."

He: "It sure does. Twenty years ago we were both seventeen. Now you're twenty-four and I'm thirty-seven."

* * *

"Is Jim a tightwad?"

"Well, every time he takes a nickel out of his pocket, the Indian blinks at the light."

* * *

Boy: "Shine your shoes, mister?"

Instructor: "No."

Boy: "I'll shine them so you can see your face in them."

Instructor: "No, I told you!"

Boy: "O. K.—coward!"

* * *

LAS Student: "Have you read the professor's new book?"

E.E. Student: "Yes."

LAS Student: "What do you think of it?"

E.E. Student: "Well, to be frank, I think the covers are too far apart."

* * *

"Hello."

"Hello."

"That you, Jake?"

"Yep, this is Jake."

"It doesn't sound like Jake."

"Well, this is Jake speaking all right."

"Are you sure this is Jake?"

"Sure, this is Jake."

"Well, listen, Jake, this is Henry. Lend me fifty bucks."

"All right, I'll tell him when he comes in."

* * *

There is only one engineer who ever became rich. He recently died in Colorado and left a fortune of $50,000 which he amassed through unceasing toil, superhuman perseverance, remarkable ingenuity, and the death of an uncle who left him $49,999.

* * *

It was my intention to write a column of jokes. I have written a column. Now read the articles. They're probably funnier.